Editorial

I WAS particularly interested to read an Editorial in the English Wireless World for May of this year. It referred to tests being made by the BBC on 90 Mc with both AM and FM to determine how they compared for broadcasting.

Wireless World makes the point that its past criticism of FM for VHF broadcasting was not an indication of being pro or anti either system, but of a desire to see the position fully analysed.

This attitude is exactly the same as our own. We have been outspoken on this very point because we also were not satisfied that enough data had been collected on which to base any opinion.

The English journal forecasts that the results of the tests will show that FM is to be preferred from a purely technical viewpoint. But it raises the same doubts as we have raised—whether the complexities of receivers and their maintenance will allow the public to reap the technical benefits.

We should never forget that broadcasting stations exist to give the public programs. No system is the slightest use if it requires receiving equipment too costly or too difficult to maintain.

I wonder whether Wireless World has received, with us, caustic criticism from people who think all those who do not blindly advocate new ideas are automatically opposed to them. More recently we have been accused of antagonism to television just because we won't close our eyes to its disadvantages and dangers.

But we have every reason to probe for the facts about these things, to present these facts to our readers, and from them to draw the conclusions we think logical in the light of those facts. No other opinion on this or any other subject is worth anything.

The results of the BBC tests on VHF transmission are not yet available. They will be of the greatest value to Australia. Particularly as it appears that VHF transmitters of modern design and adequate power have much the same coverage as the present medium-wave stations.

It seems that, some day, such stations will be the answer to our own radio problems. But we are not in a position to plan such services at present. Even without the prospect of television, which will absorb vast amounts of money and facilities, our national financial position makes their employment extremely doubtful for a long while to come.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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Vol. 13 No. 4

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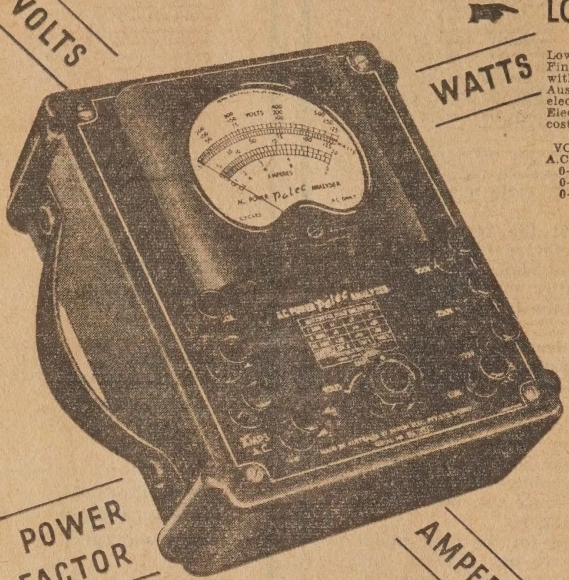

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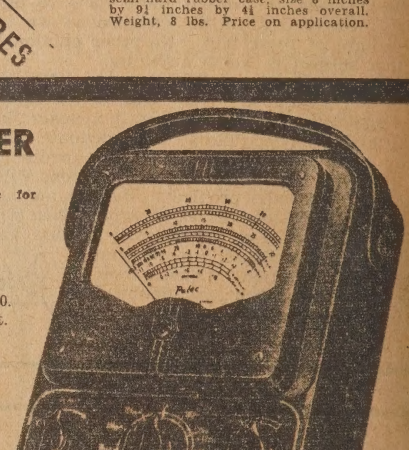

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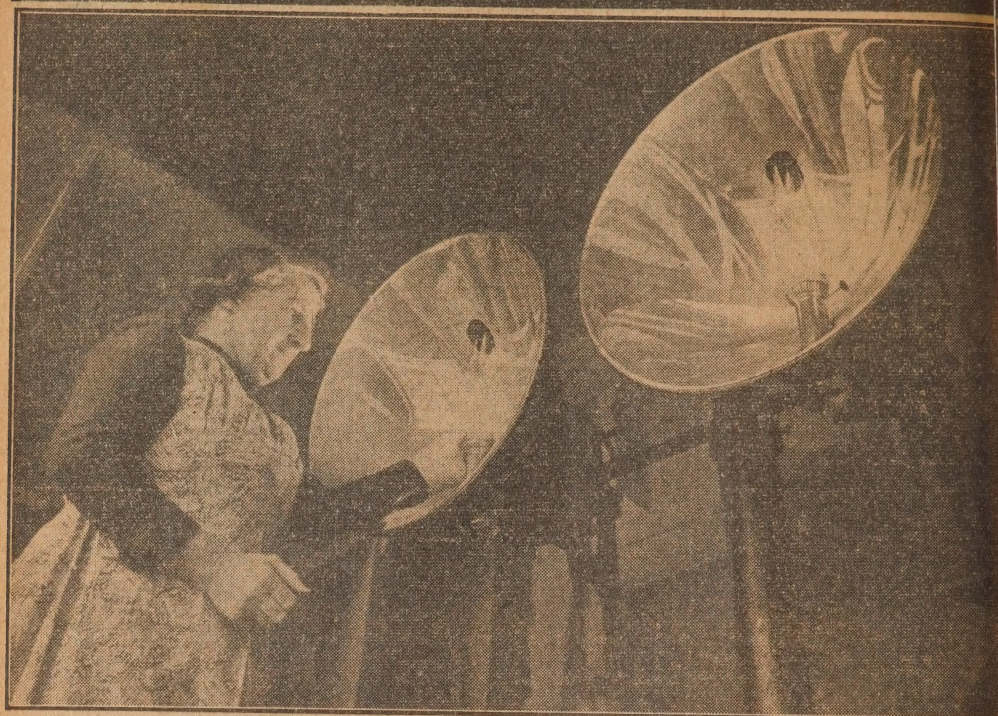
THE LIGHTS THAT MUST NOT FAIL

EVERY coastline in the world is ringed with a band of blinking lights—signalling to ships that pass in the night so that their passage shall be safe. Shown above is a light buoy being serviced and refuelled by the men who watch over the lamps of the sea. In the following pages is the story of ocean lights and the men who keep them burning in every land.

SAFETY SIGNPOSTS OF THE SEA



In contrast to the maze of prisms, lenses, and high pressure lamps of today, these two oil lamps are still in use on the NW Lancashire coast.

Living most of his life among the eternal and unchanging wonders of nature, the navigator develops into the most conservative-minded of all men. At sea, he has the signs in the sky; he has but to lift his eyes to the clear sweep of the heavens and, from the mutitudinous stars, steer his course by the twinkling lights he knows better than his own children.

By Captain Ronald Creasy

ON approaching land he is nearing a different element, the territory of man where artificial signs have been erected to warn him of dangers and to lead him into haven.

Everyone feels the romance and the glamor of the lonely lighthouse sending its beams across the angry seas to the ship nearing the fringe of its natural paddock, but few know anything behind the scenes of the lighthouse and its offspring.

Coastwise indicators of locality are found in most parts of the world and may be lighthouses or lightvessels, or their smaller counterparts, beacons and buoys.

Which is used depends upon the importance of the light and upon whether it is built on a solid foundation or is afloat. A lighthouse, the most reliable of navigational aids, is a solid structure built on land or rocks where a powerful light is needed, as at places where a ship is likely to make a landfall.

The older type has a complicated mechanism for operating the period of the light and giant revolving reflectors floating in mercury to intensify it. The modern one has flashers and prisms instead of reflectors. Its power is governed by the number of acetylene burners or electric globes and prisms.

To avoid wastage of light there is a thick magnifying belt through the centre of the optic. The upper and lower prisms gather the higher and lower rays of light and throw them through the centre of the belt, producing a powerful horizontal beam. The beam may show continuously, but rarely does, as it would then be difficult to discern from others. More often it is flashing or occulting.

A flashing light shows a beam for a moment and then relapses into darkness; an occulting light shows almost continuously, but momentari "bats an eyelid" at regular interva As a ship sails along a coastline passes lights of certain characte istics; a captain can then deduce fro a notation on his chart which pa of the coast he is near.

Flashing and occulting lights a often grouped to make recogniti simpler: Macquarie light at Sydn Heads flashes twice every ten second Some lights completely change color and are described as alterna ing. These are uncommon, as whi lights are more intense.

As well as these combinatio lights placed near dangers often ha colored sectors. Grotto Point lig in Port Jackson's entrance sho red, white and green. If the capta sees the red sector he knows he is danger of being wrecked on Sou Reef. In the white sector he is saf If he sees green he is too close North Head.

Some of these lights are ve powerful. Macquarie light can b seen twenty-five miles away. De Island, in Bass Strait, shows a millio

lle-power flash which can be seen forty miles. It is one of the most erful lights in the world. It is the second highest. A thousand above the sea, its altitude is passed only by one on Gavdo nd, in the eastern Mediterranean, ch is 1181 feet above high-water l.

is interesting to note that only lighthouse in the world is built imber from a wrecked ship. It ds on Rane Island, in the Great rier Reef. It was the work of a e of convicts.

Where a low powered light is suffi- t a beacon is used. Usually a nework supporting an unattended t. Beacons are most common r harbors but may be seen else- ere, as on parts of the Great Bar- Reef. Some small beacons are marks only and have no lights.

GHT VESSELS

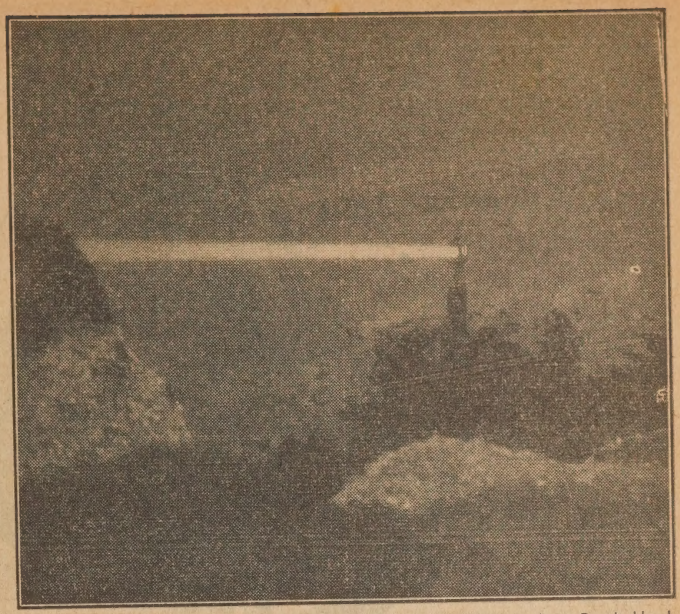
f a powerful light is needed off- re to mark dangerous shoals and tain entrances, with no hard bot- n on which to build, a lightvessel anchored. About a hundred feet g, it has a stoutly built mast, at top of which is the "moon box," veighty light mechanism slung in bals to keep it upright when tur- ent seas make the vessel roll.

Usually such a vessel is painted red h the name of the locality on the es in large white letters. These ors are more outstanding than ers in hazy weather. Lightvessels more widely used around the sts of Europe and North America. stralia has only three — Carpen- ia, the western pointer to the dan- ous Torres Strait; Breaksea Spit oth in Queensland waters) and nguin Shoals, off the north-west st of Australia. Riding to the tide they lie at anchor, they tell the riner the direction in which tidal luence is setting his ship.

In similar places if a low powered ht will suffice buoys are moored. various shapes, they consist of a um surmounted by a framework hich carries an acetylene light, the ole floating in the water. Flash- g is controlled by an automatic ning apparatus. Where buoys are se together some may be unlighted. An innovation of recent years is the sun valve. It is employed with acetylene lamps, turning the gas on at dusk and off again at dawn. A small pilot light, as in the old-fashioned street lamp, burns constantly. Bright objects reflect light. Dark ones absorb it and expand slightly.

The valve consists of four bright bars of metal reflecting daylight on to one dark bar, the expansion of which is magnified by a lever sufficiently to actuate the switch controlling the supply of gas.

The shape and coloring of a buoy tell the mariner in daytime on which side the safe channel lies. Each country has its own system of shapes and colors, and these are described in a wonderful series of books covering the coasts of the world known as the Admiralty Sailing Directions.



A striking picture of a lighthouse beam of 274,000 candlepower from Beach Head lighthouse near Eastbourne, England. It can be seen for 16 miles.

Main lighthouses have powerful fog signals. So, too, have most light-vessels, but not those in Australian waters, as they are unmanned. Instead, they have bells operated by wave motion. Fog signals sound with regular characteristics to make them recognisable in thick weather.

THE DIAPHONE

The diaphone type is a kind of trumpet in which a brass reed is vibrated by compressed air. Its high note falls low and ends in an unmistakable "grunt" as the force of the compressed air is lessened. Its low note especially is very effective and is heard farther. Los Angeles harbor's diaphone has been heard thirty-three miles distant.

At Port Reyes, in California, a large diaphone was placed halfway up a three hundred-foot cliff. It caused so much vibration that small bits of rock were loosened from the sandstone and reinforcement of the cliff with cement was carried out to prevent landslides. If you were within thirty feet of a diaphone your ears would be injured.

A deaf person would "hear" the sound through the skin a mile off. The stentorian blasts are a godsend to fogbound captains but a curse to those who tend them. Even so, off-duty keepers somehow manage to sleep not far below.

A buoy is not given a sound signal unless it marks a turning point in a channel. It may have a bell which rings as the sea makes it roll, or a whistle, the sound being produced by air which is drawn in and compressed during the up and down movement of the buoy from wave motion. It sounds like a dirge, according to the roughness of the water, it breathes sighs, whistles or just gasps.

Wireless signals are much used in fog nowadays. They are code signals

A typical lightship riding out a storm in the Thames estuary.

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bearings of which are picked up direction finders on board ships, ling a captain to know the direc- in which the station lies. Often are synchronised with mechan- foghorns, in which case the in- al between the wireless signal, ving instantaneously, and that of the sound signal synchronised it, travelling at the slower speed ound, tells the distance from the ion.

RELESS BEACONS

arious types of wireless beacons in use. One, the talking beacon, a mechanical fog signal and a lo telephony transmitter contain- a gramophone record which aks the name of the station and s distances in cable lengths up to istance of five miles.

he distances are spoken on the io at intervals corresponding to time taken by the sound to travel h spoken distance. Since wireless eard instantaneously, the listener the ship notes which spoken dis- ce he hears at the moment the chancal signal is heard.

n storms, seamarks are liable to damaged. The Bishop Rock light- use, off England's west coast, is ift high. Probably the most ex- sed in the world, it faces the almost redible fury of Atlantic storms. is stone tower has swayed on its k base in heavy weather suffi- ntly to spill mercury from the big wl in which the nine-ton reflector is floating. Its windows, near the p, have been broken by seas.

This structure marks the eastern d of record speed runs for mam- oth liners. Cape Don lighthouse, the Northern Territory, has been nown to spill its mercury in addi- on to having been split by lightning.

ELIABILITY

When larger ships run for shelter, ghtvessels stay on station to face ie elements. Their reputation is uilt on reliability, and, come what ay, the lights must shine when arkness falls. Some lightvessels ave been lost in bad weather. The eight of the light and its reflectors considerable, and is inevitably high p. This reduces the stability of the raft and in severe weather its heavy oll can be dangerous.

In 1936 one capsized in a gale off ermany's north-west coast with loss f life. Beacons are often swept way. Buoys may drag their moor- ngs. In recent years a buoy mark- ng the Frying Pan shoals, off the ast coast of the USA, broke loose nd drifted across the North Atlantic o European waters, giving out its ight all the way like a wandering tar.

Many lighthouses have keepers ermanently stationed to keep the ight functioning properly. Un- ttended lights are visited by light- house tenders belonging to the marine authority which controls the coastal lighting. In Australian seas these visits occur every three months. The Commonwealth Government maintains three ships for the pur- pose. The Cape York tends Vic- torian, Tasmanian and South Aus- tralian lights, the Cape Otway those of Western Australia and the North- ern Territory, and the Cape Leeuwin is employed around Queensland's numerous lights, including those of the Great Barrier Reef.

New South Wales has only two lights offshore: South Solitary Island and Montague Island. Their needs are supplied by launches from Coff's Harbor and Narooma respectively.

The cost of these services is borne by shipowners. They pay light dues in proportion to the tonnage of their ships.

Some lighthouse keepers have their families living with them, either in the tower itself or in an adjoining building. Their lives are essentially lonely in all but a few instances where their strange homes are close to a seaport. Unless they tend a tower on the mainland they are isolated except for periodical visits by a tender bringing fresh stores and mails. Australian keepers change to a different station every two years.

Schooling for the keepers' children in most cases is by correspondence, as in the great outback, but Victoria's Cape Otway has a lighthouse with a school attached. The State Education Department provides it and a teacher for the children of the four keepers. This lighthouse has the largest colony of any in Victoria. It is, even so, a distant outpost of civilisaton. In winter it can be approached only by crossing miles of boggy earth in a bullock transport.

Few people would be willing to change their occupations to tend these remote places. Until scientific methods completely revolutionise the conducting of ships they will be necessary.

As in the past, men have been found to do the vital work, so in the future will hardy people keep the lights shining brightly into the night to tell the shipmaster bringing his ship across the ocean that he has once again passed the acid test of making a good landfall.

MEASURING THICKNESS BY COLOR

A new kind of "yardstick" which uses different colors to measure millionth-of-an-inch thickness has been developed by Dr. Katharine B. Blodgett, of the G. E. Research Laboratory. Called a "step gauge," it is used to measure thicknesses of materials occurring in the form of extremely-thin films.

AN example of such films common to the layman would be an ordinary soap bubble of the type that reflects iridescent colors, she said.

The step gauge is used like a yard-stick, but in place of linear inches are blocks of different colors each of which represents a different thickness. The blocks of color are mounted on a length of glass in the shape of a measuring rule.

In films a few millionths of an inch thick, colors vary with changes in thickness, permitting a particular color to indicate a particular thick-ness.

In using the step gage, the color of a film of unknown thickness is matched to that block of color on the step gauge, which is the same or similar. A thickness reading marked underneath that particular block of color on the step gauge indicates the thickness of the unknown film.

Color blocks on the step gauge run from one-millionth-of-an-inch thick to 30 millionths, although gauges with wider ranges can be made, she said.

A solution of stearic acid is first spread over a surface of water con-taining berium, this solution spon-taneously spreading out so finely that it is only one layer of molecules thick.

Then, by a dipping process, a special glass plate in the shape of a ruler is dipped in and out of the solution in such a manner that it collects coatings of the solution. Each coating represents a thickness of one layer of molecules.

Ten such coatings applied result in a film on the glass plate one-millionth-of-an-inch thick which re-flects one particular color.

The glass plate is then adjusted so that one portion of it representing the first block of color does not dip into the solution. The rest of the plate receives another 10 dippings and another 10 coats resulting in a film two-millionths-of-an-inch thick.

The process is repeated until the desired range of thicknesses and colors is obtained.

The step gauge is also a valuable tool for measuring ultra-light weights. Knowing both thickness and density of a material, its weight can be computed.

FASTER LIGHT

BETTER aiming of ships' guns by radar is expected to result from the use of new value for the speed of light announced in Stanford, California.

The new value, 299,789.3 kilometres per second (approximately 186,280 miles per second) is about 13 kilo-metres faster than the generally accepted figure. Stanford claims a possible error, plus or minus, of only four tenths of a kilometre per second. This claimed error is much smaller than the differences in the various values for the speed of light found by other investigators.

The recently announced value is spurring scientists to further ex-periments to set this fundamental unit with a margin of error that leaves no room for doubt within practical limits as to the correct figure.

Many measurements of the velocity of light using visible light have been made, each investigator generally claiming a high degree of accuracy. The differences between the results obtained, however, far exceed the limits of accuracy set by the experi-menters. Reconciliation of these various determinations is the present concern of physicists.

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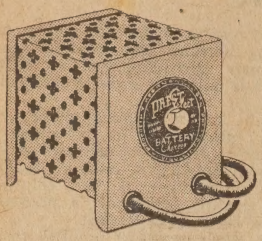

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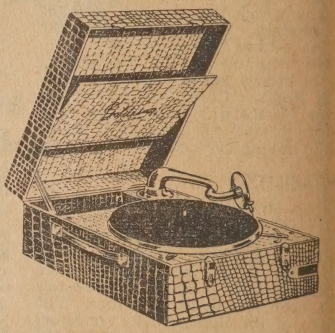

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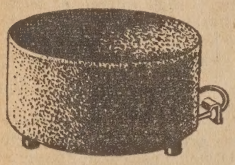

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BELL'S TELEPHONE IS 75 YRS. OLD

Seventy-five years ago — March 7, 1876 — Alexander Graham Bell was granted the first basic patent on the telephone, a red letter occasion in the history of communications. Three days later, March 10, 1876, in Bell's rooms at 5 Exeter Place, Boston, the new "membrane - speaking" apparatus transmitted its historic first sentence in the voice of the inventor—"Mr. Watson, come here, I want you!"

This famous painting shows Alexander Graham Bell with his assistant, T. A. Watson, in Bell's laboratory in 1877. In this room Bell would work far into the night, and from it he spoke the first words heard over a telephone.

HE 75th anniversary of the patent finds approximately 75 million lephones in use throughout the orld, notes the National Geographic ciety. Nearly three-fifths of them e in the United States.

The current milestone suggests a ance at other patents, inventions, id ideas of this versatile Edinburgh-rn genius, whose quest for a better eans of teaching the deaf to speak d him to invent the telephone. at the record shows that Dr. Bell ould have been long and well membered even if he had had no art in his greatest invention.

HE PHOTOPHONE

In 1879-80, Bell, satisfied to leave evelopment of the telephone largely others, worked on a quite fantastic lea—telephoning without wires! He ked to regard his resulting photo-hone, patented in 1880, as his great-st invention.

The photophone transmitted the orld's first wireless telephone mes-ages. Conveyed on electromagnetic adiations, they were forerunners of he successes of Marconi, De Forest, nd other much later inventors. Bell, owever, used light rays instead of adio waves to transmit variations of ound, thus limiting the medium to line of sight" distance.

Using the 10,000 dollars of France's olta prize for inventing the tele-hone, Bell in 1880 established the Volta Laboratory in Washington. There, with associates, he perfected methods for using wax cylinders and discs to make recordings for Edison's phonograph, invented in 1877.

Always interested in the idea of human flight, Bell in the 1890's helped Samuel P. Langley build a steam-powered model plane that flew but carried no pilot. For 15 years he studied kites by way of seeking a plane structure that would fly at low speeds. He helped develop the aileron, which replaced the wing-warping methods of controlling airplane flight.

As far back as 1908, Dr. Bell observed in his magazine writings: "The airship will revolutionise warfare . . . it may become a warfare exterminating agency and thus end all armed conflicts. *The nation that secures control of the air will ultimately control the world.*"

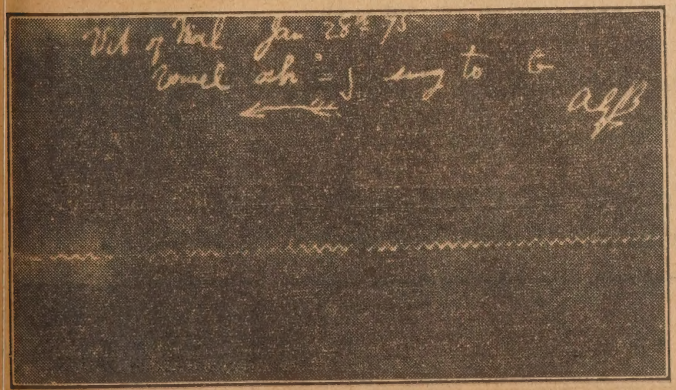
The shooting of President Garfield in 1881 and the suspense of the 79-day vain struggle to save the Chief Executive's life prompted Bell to invent an electric probe for locating bullets or other metal in the human body. It was used in surgery until supplanted by Roentgen's discovery of the x-ray in 1895. In 1882, Bell suggested a device to restore breathing that embodies the principle of today's iron lung.

ACTIVE LIFE

Until his death at 75 on August 2, 1922, Dr. Bell's active mind continued its searchings. He delved into distilling fresh water from salt, high-speed motorboating, sheep breeding, human longevity, the metric system and air conditioning.

To beat oppressive Washington heat, Dr. Bell installed a refrigerator in the attic of his Connecticut Avenue home, and filled it with large blocks of ice covered with salt. An asbestos-covered duct led the cold air down to a room, which was kept as nearly sealed as possible at the bottom to retain the sinking cold air, while its windows were opened at the top. While diplomats and legislators sweltered, the thermometer in this air-conditioned chamber registered a cool 65 degrees.

Dr. Bell helped found the National Geographic Society in 1888, helped finance it through early years.



Examining the mechanism of the ear, Bell obtained an ear from a doctor friend and made this smoke tracing by means of a straw fastened to the eardrum. The wave form represents the vowel "ah" sung in G.

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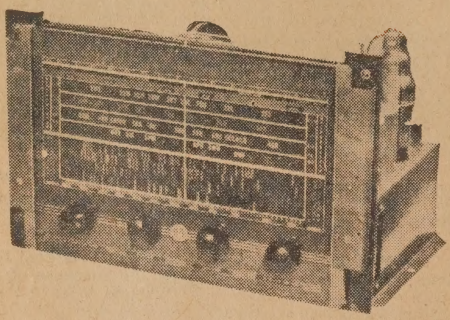

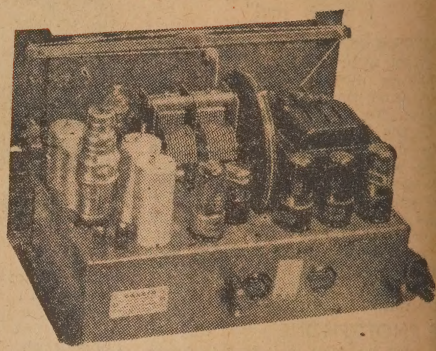

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CLASSIC RADIO

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THE FUTURE WILL BRING NEW JOBS

Ten or twenty years hence millions of men and women will be working at jobs which do not exist today because the industries are still in their infancy. It has happened before, as in the case of plastics.

by Professor A. M. Low

A FEW years ago the number of men and women making a few ple articles in plastics was only w hundred. Now it must amount countless thousands, and it would a bold man who suggested that number will not be multiplied eral times within a generation.

The number of workers in the ctrical industry a century ago s negligible. In 50 years it has wn into millions as the result jobs "created" by inventions such the dynamo, the electric motor, ctric lighting and radio.

EW INDUSTRIES

In more recent time we have seen mpletely new industries grow im feeble beginnings to full ture. Artificial silk was in the abryo stage not so many years o and the industry seemed as pre- rious as the thread produced. But n had faith in the idea and syn- etic textiles today are common- ace.

Always the difficulty has been a ortage of technically trained young n and women to enter the new dustries, because there has been little foresight.

The motor industry, when it began grow rapidly, had to recruit men om other trades. Viscount Nuffield mself, it will be remembered, graduated" from bicycles.

Today there are probably more new" industries in process of grow- ng up than we have ever known. ur success with them will depend ery much upon having the right oung men and women to take an nterest and to train in readiness or the day when recruits are eeded.

What are the industries that will ffer tomorrow's new jobs? Radio, uilt up almost entirely since the ar, should expand greatly, especi- lly if we can build the kind of quipment wanted by other coun- ries which have no radio industry f their own.

TELEVISION

Television will bring millions of ew customers, at home and abroad, nd, if we are enterprising, there s not likely to be a mere "boom" ollowed by a slump when all the ustomers have their sets.

If sets can be made so cheaply hat it "pays" to replace them every ew years (as with cars) there will e a continuous demand, and it will soon be possible to introduce mprovements such as "stereoscopic" nd color reception.

A great number of the workers in the radio industry will be comparatively unskilled, but, with an expanding industry, there should be a steady demand for the technically qualified men.

They will be required for erecting installations for repairs, for the servicing of sets that will become more complex, and for design or testing.

We began the postwar period with the asset of many thousands of men and women trained to varying degrees in the Services, but we should also ensure that there are plenty of boys today with the opportunity of becoming the highly skilled radio engineers of tomorrow.

It is fashionable to minimise the value of a degree or other institutional qualification, but from long experience of engineering I would encourage the young man to qualify before anything else. It means more than a string of letters after his name unless, of course, he is just a memory-examination crank.

ELECTRONICS

Radio is only one branch of a great new industry with a name which is not even generally familiar —"electronics." This really covers the whole field of devices in which the electron is harnessed.

Astonishing things are being done with "electrons" today. Radar is now just one example of the control it permits. Cooking without outside heat, smoke and dust collection, new forms of lighting, magnification on an unprecedented scale, completely automatic sorting and testing of almost every kind of product—these are a few electronic devices well past the experimental stage.

There seems almost no limit to the complexity of the manufacturing process which electronic devices can control automatically.

The device that guides a remote-controlled gun in a bomber on to a fighter weaving in at 500 mph will be adapted to the control of manufacturing processes requiring equally intricate calculations.

The future for electronics is as bright as was the future of electrical engineering 70 years ago—perhaps brighter, for progess is likely to be much more rapid. It will give thousands of skilled jobs to young men who today hardly know its name. They will handle with ease devices which, to their fathers, will seem little less than "magical."

Another industry likely to offer great opportunties, although, perhaps, less dramatically, is that of new metal alloys.

The war has seen a tremendous development in the use of magnesium and aluminium alloys with all their advantages of lightness with strength. A development such as the perfection of a magnesium alloy suitable for cooking utensils would see today's demand as great as that in war.

VARIETY OF ALLOYS

The number of possible alloys of the metals is virtually infinite, and new industries will be based on harder metals, springier metals, stronger metals, on alloys specially designed for making every kind of machine—from a watch to a locomotive—more efficient and hard wearing.

That plastics will offer thousands of new jobs hardly needs emphasis. If we can find the technicians there seems a great opportunity in the next ten or twenty years to develop completely new fabrics which may well be a combination of natural with the synthetic fibre.

The plastic house may be far away but it is obvious that new industries are going to be based upon the plastic-impregnated plywood that has shown itself as strong as steel in aircraft.

A new industry may also be founded on the discovery of methods by which common woods can be impregnated with chemicals to make them as strong and effective as oak or other more valuable hardwoods.

CIVIL AVIATION

What about aviation? After the tremendous "boom" of the war it seemed likely that the number of qualified men would far exceed the demands for civil aviation for many years to come.

Admittedly, on the present lines of development, it does not look as if civil aviation will offer a career to more than a comparative handful of top-line men for some years. However, when the new era

(Continued on Page 95)

When we are hot, evaporation of perspiration keeps us cool. This little chap mops it from his brow during a heat spell.

YOUR PERSONAL THERMOSTAT

We all know how unpleasant are the effects of too much heat or cold. Nature has provided various compensations to keep our human chemical factory at optimum temperature. This article tells you how this is done.

by Calvin Walters

THE human body is a machine of great complexity. It does a great amount of work and depends on the production and dissipation of heat for its existence. This heat must be confined to narrow limits.

The body must therefore be provided with a thermostat to control this heat.

The fact that temperature has a great deal to do with our personal comfort is well known. We unconsciously apply terminology relating to temperature to denote pleasure or displeasure.

For instance, we say "things are not so hot" when the wife goes "crook" because you forgot to post her letters. She "gives you a cold reception" when you come home too late from the club.

HOT AND COLD!

The boss also has a habit of "giving you the cold shoulder" when you ask for a rise.

On the other hand, a piece of music is often classified along with certain beautiful women as "hot numbers."

Then there are those songs which deal with "burning desires" and stories which speak of "flaming" youth."

People go "cold" on a project or former sweetheart. They "warm up" to their subject when making a speech and get "hot under the collar" when interrupted by too many interjections finishing up by going "cold" on the matter.

VAST FACTORY

The human body is a vast chemical factory. Within it are carried out most intricate chemical reactions. It performs functions which, if carried out by artificial means in a workshop would require teams of men and supervisors, large stores of chemicals, fuel and great furnaces, and devices to control the temperature.

Remodelling of the atom to create complex substances from simpler ones, the conversion of starches into sugar for fuel, the manufacture of acids and alkalis and the elimination of wastes are all carried out in the human body.

Electric impulses are created and used in the brain for the transmission of messages through the nerves to vital centres of control.

Delicate machinery which uses almost every principle of mechanics is located throughout the body in the bones and tendons and muscles.

Universal joints exist at various points throughout the system and these are self lubricated.

MANY PROCESSES

Photographic processes function in the organs of sight. Acoustic forces exist in the ears wherein are also located the delicate instrument which enables us to keep balance on our two feet.

The cells of the body tissue are constantly dying and being replaced. Sensitive cells of the stomach secrete juices which act chemically on the food we eat to form nourishment. This is conveyed to the blood stream which in turn carries it to every part of the body where, by a remarkable process of osmosis, it diffuses through delicate cell membranes to feed the cells themselves.

All these functions must be carried out at a certain temperature which must be so accurately controlled that it does not vary more than about a degree above or below 98 degrees Fahrenheit.

Whether it be in the regions of intense equatorial heat in Central Africa or regions of intense cold near the South Pole, whether the human body is resting or working like mad for the few pence one gets per week the temperature seldom varies from that vital 98.4 degrees.

It can really be said that the cells of which the body is composed are tropical individuals. As such they cannot live outside a very limited range of temperature variations.

RIGID TEMPERATURE

The cells can be likened to the sensitive tropical fish one sees in aquariums. Outside tropical waters they must be confined in a tank the water of which must be controlled to a temperature of about 78 degrees.

There is not one activity of the bodies which does not involve the production of heat. This is particularly so in regard to muscular activity.

The cells of muscles can be likened to the combustion chambers of

nal combustion engine as used otor cars.

these engines the cell or com- n chamber is fed with an explo- mixture of petrol and air. In the ss of exploding and burning, the is forced down and made to rm useful work.

it is that every cell of the and particularly the muscle are small furnaces which burn consume the particular kind of fed to them by the bloodstream. fuel enables the muscles to rm work which is, alas, not al- useful, but work nevertheless.

living muscle could be examined r the microscope we would see ed corpuscles of the blood flow- through the capillary tubes sur- ding the muscle cells.

ese corpuscles are loaded with en picked up on the journey ugh the lungs.

the fluid part of the blood there arried the particular kind of which is required for burning he muscular cells.

RK AND WASTE

hen the fuel and oxygen are mix- n the cell it burns and in doing so ives off a waste gas, carbon di- ie, which is discharged through exhaust pipes of the veins and ied away by the lungs.

hen the muscles are working, the is consumed at some 12 times rate as when the muscles are est.

uscles do not give the fiercest t although they are the most ensive furnace system of the y. The liver is a very hard ker and gives off an enormous ount of heat.

his can be understood when it considered that the liver is a mical factory of great magnitude the processes concerned require production of a great amount of t.

ll digestive processes are respon- le for heat production, as also are kidneys and the lungs.

Heat is measured in calories. A orie is the amount of heat re- ired to raise the temperature of e kilogram of water one degree ntigrade.

ALORIES

Estimation has shown that a man ighing 11 stone, taking no food d resting for the day (such a thing not done except as an experi- ent) produces 1700 calories of heat. this, 1200 calories are produced the muscles and 500 by the glands.

When, however, a man leads a nor- al life, works a bit, and has a cent meal, the calorie production stepped up. But the muscles then oduce 90 pc of the heat and the ands only 10 pc.

It is quite evident that with all is heat production the body must provided with the means of get- ng rid of it otherwise we would st burn away to a cinder.

On the other hand we don't want lose too much, otherwise we would die of cold because the cells could not produce fast enough to make up the deficiency.

It requires, therefore, that we be provided with a thermostat. Nature has provided just that mechanism.

When we want to warm up a room we either stir the fire or shut the windows.

If the room is too warm we douse the fire or open the windows. The body does much the same thing. It either raises or lowers the rate of combustion or increases or decreases the rate at which heat escapes from the surface of the body.

MUSCULAR HEAT

As we pointed out previously muscles are a prolific source of heat when at work. It is obviously much easier for us to stimulate our muscles to action and thus produce more heat than it is to stimulate, say the liver, except by methods which have undesirable after-effects.

Thus, it is that we can "keep warm" by working our muscles. This feeling of warmth on a cold day offsets somewhat the undesirable thought of having to work at all.

Nature sometimes causes us to work our muscles involuntarily by making us shiver or chatter our teeth. This is to provide warmth.

We wave our arms and rub our fingers to stimulate muscular activity. In cold weather most of us favor a heavy meal of meat and vegetables quite without thinking why.

The reason of course, is that nature wants it this way, so that extra fuel will be provided. The liver is specially stimulated to action by a meat diet.

The glands of the body also provide secretions which, added to the bloodstream, step up the rate of combustion. The thyroid gland is particularly useful in this respect.

The skin is a most important organ for the regulation of heat.

The skin is provided with temperature transmitters which send messages to the brain stem and spinal cord. These transmitters convey information concerning the state of the surrounding temperature. The brain and spinal cord then transmit messages to all parts of the body regulating the rate at which combustion is carried out. On a cold day the messages order the speeding up of combustion and on a warm day the rate of combustion is retarded.

Thus it is that the skin is the most vital factor in the regulation of heat.

The skin is permeated with small capillary vessels which flood it with rich supplies of blood.

ARTERIOLES

The small arterioles which supply this capillary field are provided with mechanisms which act in the nature of stopcocks. These are controlled by centres in the brain and spinal cord.

On a hot day the temperature transmitters in the skin cause the brain to open the stopcocks and flood the skin with warm blood. This causes the radiation of a great amount of heat from the surface of the body aided by currents of air which rise from the surface of the body and carry away the surplus heat.

The reverse is the case on a cold

(Continued on Page 77)

A delightful picture of two Eskimo children well wrapped to prevent loss of heat. Eskimos eat plenty of animal fat to generate extra warmth.

"FIDELITY"

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PUBLIC ADDRESS AMPLIFIERS

SPECIFICATIONS—MODEL X4. PRICE £23/4/-

INPUTS, high impedance, gramo, .5 meg., microphone .1 meg.

SENSITIVITY, gramo .25 volt, microphone .002 volt.

POWER OUTPUT, 4 watts. Noise level, —45 db.

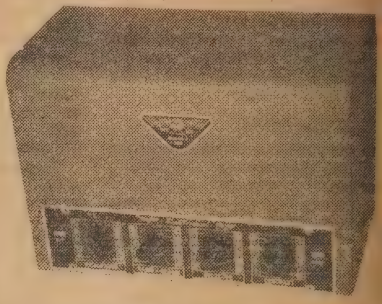
DISTORTION, maximum 5% at full output.

OPERATING VOLTAGE, AC 240 volts.

OUTPUT IMPEDANCE, 600 ohms.

VALVES, 2/6AU6, 1/6AQ5, 1/6X4.

DIMENSIONS, 10½" x 7" x 4⅜".



Specifications—Model X15 Price £40/0/10

INPUTS, high impedance, gramo .5 meg., microphone .1 meg. radio .5 meg.

SENSITIVITY, gramo .25 volt, microphone .002 volt, radio .25 volt.

POWER OUTPUT, 15 watts. Noise level—50db.

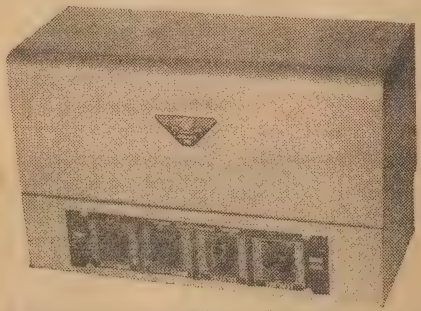
DISTORTION, maximum 5% at full output.

OPERATING VOLTAGE, AC 220, 240, 260 volts.

OUTPUT IMPEDANCE, 600, 300, 150, 75, 37.5, 18.75 ohms.

VALVES, 2/6AU6, 1/6SN7GT, 2/6V6GT, 1/5V4G.

DIMENSIONS, 13¼" x 9½" x 8¼".



Specifications, Model X30. Price £43/18/6

INPUTS, high impedance, gramo .5 meg., microphone .1 meg., radio .5 meg.

SENSITIVITY, gramo .25 volt, microphone .002 volt, radio .25 volt.

POWER OUTPUT 30 watts, noise level—50db.

DISTORTION, maximum 5% at full output.

OPERATING VOLTAGE, AC 220, 240, 260 volts.

OUTPUT IMPEDANCE, 600, 300, 150, 75, 37.5, 18.75 ohms.

VALVES, 2/6AU6, 1/6SN7GT, 2/807, 1/5V4G.

DIMENSIONS, 16" x 10" x 8¼".

Specifications—Model XV25. Price £50/15/-

INPUTS, high impedance, gramo, .5 meg., microphone .1 meg.

SENSITIVITY, gramo .25 volt, microphone .002 volt.

POWER OUTPUT, 25 watts, noise level—46db.

DISTORTION, maximum 5% at full output.

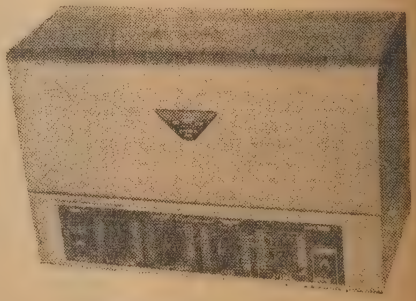
OPERATING VOLTAGE, battery 12 volts or AC 240 volts.

OUTPUT IMPEDANCE, 600, 300, 150, 75, 37.5, 18.75 ohms.

VALVES, 2/6AU6, 1/6SN7GT, 2/807, 2/6X5GT.

DIMENSIONS, 16" x 10" x 8¼".

NOTE: This amplifier is designed for use from either battery or A.C. mains. Changeover for either operation is made by simply changing connecting cables supplied with amplifier.



Details of Special Type Amplifiers, Larger Power etc., on request.

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Technical Review

A NEW RCA PROFESSIONAL TAPE RECORDER

Latest entrant in the field of professional tape machines is the RCA model RT11A. Conforming to strict broadcast standards, its design brings to light many interesting points which must be considered in the production of a high-quality tape recording and playback unit.

THE RT11A has been developed in the light of experience with s pretentious equipment and shows to the benefit of exhaustive laboraty tests. It is constructed in several parate and basic units which can mounted in a rack, as shown, or stalled in other more suitable ways r special applications.

The tape-handling mechanism, hich also includes the recording, ayback and erase heads, is built as e separate unit. All the vital comments are mounted on a single rge casting, which is attached in rn to the front panel by soft rubr mounts.

Purpose of this arrangement is to revent warping and misalignment the mechanism when screwed to ightly out-of-true cabinets. Experince has shown that even small dees of misalignment can have a rious effect on the high frequency sponse. As it is, all tape-handling mponents pass through the panel, ut with adequate clearance, so that anel distortion is not conveyed to he basic mechanism.

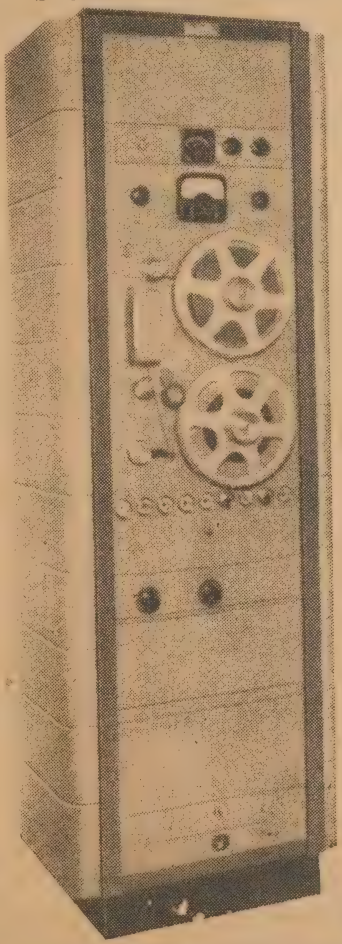
TAPE THREADING

The tape is threaded on the left-and side of the spools and from top o bottom, so that it conforms to normal practice with motion picture rojectors. When the tape deck is nounted horizontally, the tape moves rom left to right, with the tape at he front, again conforming to the best-accepted practice.

The capstan pulls the tape past the heads in the normal forward play direction, allowing the tape to be run into a basket, for editing purposes, rather than be collected on a take-up spool.

Much research went into the drive motor system. It was found that normal high-speed motors, driving the tape directly, transmit motor flutter and vibration to the tape and also call for a small high-precision capstan. Imperfections in a small capstan are a prolific source of trouble.

Slow-speed direct motors are given to "wow" effects by reason of hunting and are thus unsatisfactory for a high-quality instrument.



The complete recorder, mounted in a standard rack and ready for installation in a broadcast station. Tape handling mechanism, recording amplifier, playback amplifier and power supplies all have seperate rack positions. Cover over the heads flips open.

In the system finally adopted, a normal speed motor drives an enlarged capstan through a belt-reduction drive, and the flick of a switch changes the speed from 7½ to 15 inches per second.

The machine is essentially push-button controlled, using a series of interlocking relays, which make mechanical as well as electrical adjustments.

BUTTON CONTROL

Thus, the "Start" button pushes the tape against the already-revolving capstan and energises the take-up motor. The "Record" button, which will only operate after the "Start" button has been depressed, brings the recording circuits into play and energises the bias and erase oscillator.

For speedy handling of the tape, a "Fast Reverse" and a "Fast Forward" button is provided, suitably interlocked to prevent the tape being broken if both are depressed simultaneously. Operation of either button disengages the capstan and clears the tape from the heads by a system of sapphire guides. Both buttons can be manipulated alternatively to search the tape rapidly for a particular section.

AMPLIFIERS

A "Stop" button disengages the drive and applies brakes to the drums, bringing the tape to a rapid stop.

Separate amplifiers are used for record and playback, both containing proper compensation. The compensation is changed automatically with a change in tape speed. Convenient facilities are provided for line connections to input and output.

Separate heads are used for all functions, exceptional care being taken with shielding, to prevent the entrance of hum. ("Audio Engineering.")

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QUARTZ CRYSTALS GROWN TO ORDER

An acute shortage of natural quartz crystals in the US has speeded research into the problem of growing quartz crystals. A suitable technique has now been evolved which should render the US independent of outside sources.

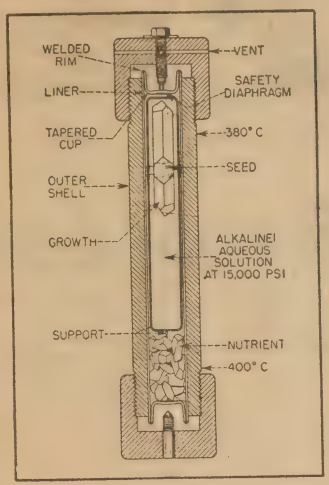
SEARCH into quartz crystal growing extends back 100 years so, but significant progress is quite ent. A promising method de- oped by Nacken, in Germany, in- ved the absorption into solution amorphous silica at a temperature 374.2 degrees C. and a pressure of 0 psi—the critical point for water.

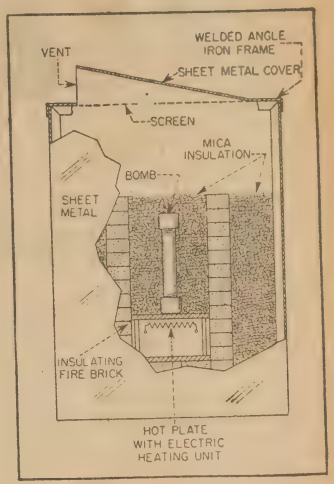
The crystal growth produced by s method was extremely rapid in initial stages, leading to spon- eous formation of crystals on the lls of the cylinder as well as on intended seed. However, growth n stopped and the objective of ge, well-formed crystals was not ained.

EW TECHNIQUE

The later technique involves eration at a much higher tempera- e and pressure figures being about) degrees C. and 15,000 psi. Under se conditions it has been found ssible to grow crystals at the rate .05in per day on each of the major es.

A special welded-seal insert car- s the active ingredients inside a gh-pressure demountable cylinder. e assembly is enclosed in a fur- ce for several weeks, as necessary, e top being deliberately kept a w degrees cooler than the bottom. The hot solution at the bottom ssolves the nutrient and rises by nvection to the top. Here it be- comes cooler and is consequently super-saturated. This is the neces- sary condition for crystal growth. The constant flow of the solution past the crystal faces maintains an even rate of growth until the process is interrupted. (Electronics.)





On the left is a cross-section of the steel "bomb" in which the crystals are grown and, on the right, the type of furnace which maintains the necessary temperature gradient.

A GERMANIUM PHOTODIODE

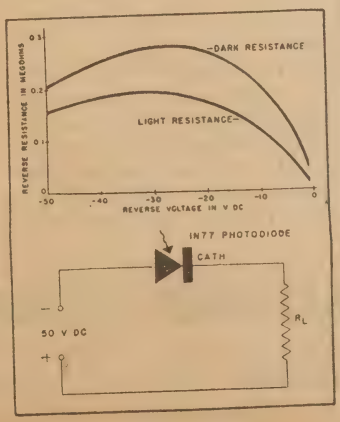
Latest addition to the germanium diode family, as announced by Sylvania is a photo-sensitive diode intended for use in miniature counting, inspecting and recording systems.

DESIGNATED as type 1N77, it has a diameter of only .08in and is designed that the incident light can be focused on the active ele- ments within the end of the tube.

Its characteristics are generally similar to other germanium diodes but its reverse resistance varies with incident light. It is most sensitive at the red end of the spectrum, the response peaking at 1.7 microns, in the infra-red region.

The accompanying curve shows the variation of reverse resistance with voltage and incident light. The simple circuit shows how it can be applied, in association with an acti- vating voltage to vary the potential across a load resistor. This can be amplified, as necessary, and used to actuate a relay system.

The application of the new diode resembles that of an ordinary photo- tube except that it is smaller and operates with rather more convenient values of voltage and load.



MOULDED MAGNETIC RECORDING HEADS

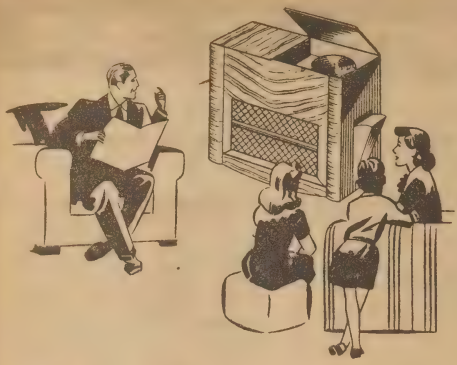
AN important forward step may well be represented in the evo- lution of moulded heads for mag- netic recorders. Evolved originally with the idea of conserving nickel alloy supplies, the new heads ex- hibit characteristics which might well indicate their superiority over the normal laminated type.

The most impressive feature of the ferro-magnetic materials is their extreme hardness, which just about matches that of the coating on mag- netic tape. This reduces head wear to the point where it cannot be de- tected microscopically, even after many hours of running.

The natural hardness of the material makes it necessary for the head to be completely lapped and finished before installation in the machine. If this is not done it is likely to damage the tape. Conven- tional laminations are seldom treated this way, the final polish being ac- quired by contact with the tape.

It becomes possible to make the front gap very shallow, thereby con- centrating the lines of flux against the tape. This leads to increased sensitivity both for recording and playback. A large number of turns can be used without increasing the inductance too much.

Considerable research will be necessary to discover the most suit- able ferrites for the different appli- cations. (Electronics.)



For the First Time in Australia

Magnetic Sound Presents:

Three-in-one Home Entertainment Unit

The Amazing new Teletape

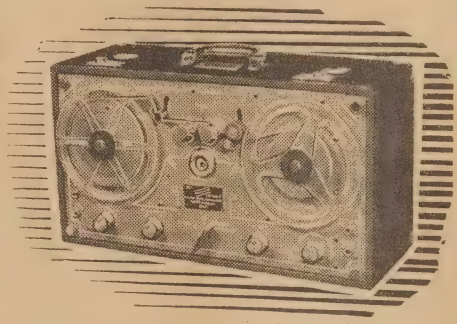
Radio-Recorder-Gram

It's a Radio of first rate quality that you'll enjoy seeing in your home. A very handsome cabinet of fine Italian figured veneer. Excellent reception and tone, worth in itself the full price.

It's a Gramophone 33⅓ and 78 r.p.m. Gramophone motor with detachable heads for ordinary records and the new, long-playing Microgroove records. Has twin record compartments. The excellent tone you associate with the finest quality radiograms.

It's a Tape Recorder Yes, now you can enjoy all the pleasure of owning a Tape Recorder, because it's here, built right into this super radiogram. High fidelity recording, without scratch or background noises. Records with amazing clarity the human voice, music, conversations, singing, etc. You can record from life by simply plugging in the mike; or at the flick of a switch it will instantly record permanently for you what is being played on the gramophone or broadcast on the radio. Your family can record for you a broadcast you won't be there to hear. These recordings can be played back instantly, erased in a minute to make new recordings, or kept and played indefinitely. Price is approximately £169/10/-.

TELETAPE PORTABLE RECORDER £115



For an easy portable, high-fidelity, easy-to-use tape recorder, the Teletape remains Australia's outstanding value! This handsome case is simple to carry to the homes of your friends to your office, or anywhere you would like to record or play back your recordings. The Teletape records a full half-hour at a time, with amazing faithfulness and no background noises of any kind. It will record speech, singing and music, equally clearly from life, radio or the gramophone. You can play back immediately, or any number of times. You can erase a recording and use the tape again.

SPECIALISTS IN SOUND RECORDING

Plenty of reels of half-hour recording tape **45/-**

One-hour reels of American and French recording wire .. **59/6**

Build your own tape recording outfits, with our tape decks **£69/10/-**

Coming soon: new release of super lightweight portable tape recording decks, about **£45**

Tape-recording motors at **£4/12/6 & £5/17/6**

MAGNETIC SOUND INDUSTRIES (AUST.)

Open Saturday mornings. **Phone M3652. OPP. REGENT**

SYDNEY RADIO THEATRE, 1st Floor, 590 George St., Sydney.

METAL DETECTOR SAVES MACHINE TOOLS

The increased use of expensive automatic machinery has highlighted the danger of damage from stray metallic particles in the material being processed. Bulky objects and materials present a particular difficulty but successful electronic detection methods are being developed.

A NOTABLE example is found in dealing with lumber, where logs y harbor bullets, drill ends or fragnts of metal from circular saws. e problem is particularly acute ere lumber is drawn from areas ich may at some time have been d for military manoeuvres.

The problem then becomes one of tecting particles of metal equivait in mass to a 5-8in diameter ball r larger — and embedded anyere along the length of a log sevl feet in diameter.

This problem was attacked by ranging a large pair of circular agnet coils above and below the rface of a sea-water channel so at the logs to be examined floated rough the magnetic circle.

TRONG FIELD

The coils carry a strong 25-cycle rrent, setting up a field, which can e disturbed by quite small pieces metal. The disturbance can be etected, either by noting a slight hange in the impedance of the main oils or by observing the effect on a rther non-excited coil.

It was found, during initial tests, hat the alarm circuit would respond o a change in field distribution as he moist end of the log approached he coils. This was overcome by volving a phase-conscious detector, which could ignore the water pulse, but respond to one from "tramp" metal.

The circuit was specially balanced and compensated also to render it less sensitive to changes in humidity and temperature, while the coils were made proof against mechanical shock.

A 48" log is poled through the twin search coils which are seen half submerged in the water. Floating the logs through the coils in this fashion simplifies handling.

An installation, covering timber taken from an area used for military operation, discovered numerous bullets and shell fragments capable of damaging high speed saws and, in addition, a number of unexploded shells.

A contrasting problem occurs with some iron ores which should ideally be checked for "tramp" metal before being fed to the crushers. In this case, metal objects likely to damage the crushers are much larger, such as broken teeth from power scoops and oddments from heavy machinery.

Low frequency search techniques cannot be used because the ore is often comparable in magnetic properties with the metallic objects which must be located.

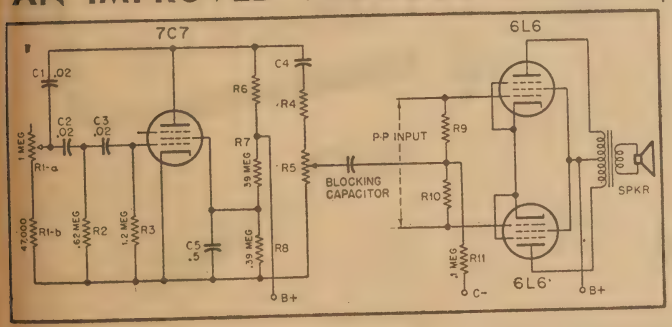
HIGHER FREQUENCY

To overcome this difficulty, it has been found preferable to use a search frequency nearer to 4000 cps and to rely on the magnetic losses in the materials. It is found that ore has very low losses, while solid lumps of steel have high losses, so that there is a very different effect brought about by the two on phase relationships in the search coils.

Once again, a phase sensitive detector serves to separate the signal and to operate an alarm system.

For handling large quantities of ore, the magnetic system consists of three magnet assemblies with the respective poles above and below the conveyor belt and covering the full width of the belt, between them. Encouraging results have been obtained with this system. (Electronic, March, 1951.)

AN IMPROVED TREMOLO CIRCUIT



THE increasing popularity of electronic music highlights the need for a good vibrator effect. Ideally, this should be a slow periodic variation in frequency, but this is difficult to obtain in practice.

A comparable effect can be achieved by varying the output from the amplifier at the rate of about 6 cps, and, to this end, a signal at the appropriate frequency is often fed to a low level amplifier.

Chief objection to this scheme is that the low frequency signal is often transmitted to the voice coil of the speaker, leading to early distortion and overload. If the tremulant signal happens to beat with a low frequency note, even more distressing effects can occur.

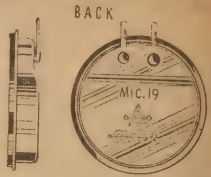
In a recent US patent, R. G. Stephenson suggests that the tremulant signal can be fed to the grid return point of push-pull output valves, the exact method of feed depending on the basic circuit. Chief advantage is that the injected signal varies the gain of the output valves, but cancels out in the plate circuit, so that no ill-effects are produced at the voice coil.

An associated phase-shift audio oscillator generates a convenient tremulant signal of controllable amplitude and frequency.

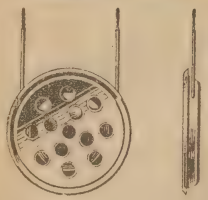
Choose your equipment from this famous range!

ACOS MICROPHONE INSERTS

MIC. 3 DIAPHRAGM-ACTUATED crystal microphone, specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity.
Price: £1/18/-.



MIC. 19 SINTERCEL fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction.
Price: £2/18/6.



MIC. 18 MICROPHONE SPEECH INSERT provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this Insert is recommended.
Price: £1/19/6.

MIC. 14 STANDARD SPEECH MICROPHONE INSERT with nickel-plate brass case which gives high corrosion resistance, mechanical strength and rigidity.
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TYPE "A" MICROPHONE. Specially designed for clear production of speech. Ideal for public address; office and factory call systems; amateur and mobile radio transmitters, etc.
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G.P.20 MICROCELL PICK-UP

The most outstanding pickup on the market! Incorporates the latest advances in pickup design and sets a new high standard in sound reproduction. The Acos MIC ROCELL has 20 times greater output than comparable magnetic types; needle talk and motor rumble is practically non-existent. Fitted with permanent sapphire stylus and automatic bass-boost which permits fitting to any domestic radio without additional equalisers. Plays Microgroove or ordinary recordings. Available from all Radio Stores. .. .. **Price: £5/17/6**
CARTRIDGE ONLY (G.P.19) .. .. **Price: £3/7/6**

Price £5/17/6

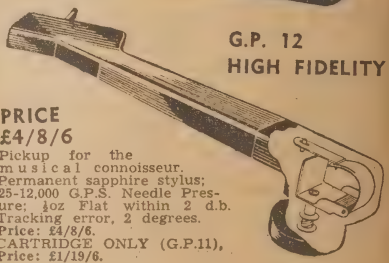
ACOS CRYSTAL PICK-UPS

G.P. 10 UNBREAKABLE PICK-UP

PRICE £2/19/9

Sturdy construction; ninety degree lift-back and exclusive needle pressure adjustment. Low Harmonic Distortion. Output 1.5 volt. **Price £2/19/9.**
CARTRIDGE ONLY (G.P.9) **Price £1/15/-.**

G.P. 12 HIGH FIDELITY



PRICE £4/8/6
Pickup for the musical connoisseur. Permanent sapphire stylus; 25-12,000 G.P.S. Needle Pressure; ½oz Flat within 2 d.b. Tracking error, 2 degrees.
Price: £4/8/6.
CARTRIDGE ONLY (G.P.11), **Price: £1/19/6.**

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SOLE AUSTRALIAN REPRESENTATIVES

NEWS AND VIEWS OF THE MONTH

ssons from Korea

)ST "minor wars" have proved valuable testing grounds for ıpons which later are used to at effect in major wars.

uring the Spanish civil war ıy aircraft in particular were ie available by both Germany Russia from which experience combat conditions taught their ıgners many lessons.

o with Korea. At the moment ıe unpleasant demonstrations of ssian jet fighter performances e shown other nations that their t efforts fall short in many ys of the standard required by dern combat aircraft.

he comparatively few commun- aircraft available during the npaign has thrown greater stress the value of anti-aircraft fire. is now learned that radar-directed is responsible for more than f the aircraft lost by the UNO ces during the campaign.

The equipment is thought to be Russian manufacture, and sug- sts that bombing of targets in future, even from heights, will an increasingly hazardous pro- dure. Superforts in Korea have been hit repeatedly while flying at more than 20,000ft.

In view of the development of guided missiles, and the threat of atom-bombing, these figures may be significant, being probably merely an indication of what could be done.

AND HELICOPTERS

Another modern development highlighted by the Korean war is the helicopter. The "flying windmill' has been with us for years, but only towards the end of the last war was it considered worth attention on any great scale. Its unique ability to fly in all weathers, to hover over a given spot, and to ascend and descend slowly and under control, made it invaluable for sea-rescue work, and for flights to spots where a normal aircraft could not land.

In Korea this rescue work has been responsible for saving the lives of more than 3000 soldiers, according to reports. In the face of a fine record of reliability, it is inevitable that a big future should be on the way.

Already two companies are vieing for the rights to commence a mail and passenger service in the New York area, transport to which becomes more difficult and congested every day. Helicopters are able to fly right over the city, and land on rooftops with complete ease.

Some of the projected machines are reported to be giants capable of handling 50 to 100 passengers, and to fly up to 150 miles per hour.

It is not anticipated that they will ever replace long range, high-speed aircraft, but rather to supplement such services, particularly on short hauls where their predecessors could not operate.

Reliability, of course, is a paramount factor with helicopters. It would be highly inconvenient to have a couple of them depositing their loads unceremoniously in the main street, or in the local zoo!

★ ★ ★

How old is man?

AMERICAN anthropologists have unearthed evidence that a modern form of man was alive at least 75,000 years ago.

Digging in a cave near Behshahr, on the Caspian Sea, Dr. Carleton Coon, of the University of Pennsylvania, uncovered three human

POPULAR SCIENCE QUIZ

Q: Over the years, many of us have encountered the term "persistence of vision." What is a simple explanation of this effect?

A. The whole point is bound up in the ability of the mind to retain an impression of a scene viewed a fraction of a second previous. The most striking example of this effect is in the motion pictures, or "movies" where 24 still pictures are each projected twice within a space of one second. Each picture, or "frame" shows movement slightly different from the one preceding it so that the overall effect is one of continuous motion. A speed of 16 frames (or 32 pictures) a second is the lower limit below which the effect of continuity is decidedly lost and the viewer becomes conscious of a disturbing flicker.

Another instance of the effect of persistence is in the cathode ray tube where the extremely rapid movement of a tiny spot of light gives the impression of a continuous line. Actually, there is a combination of eye persistence and persistence of luminosity on the cathode ray screen material.

Another example is in the use of the stroboscope whereby to the eye motion is converted to a stationary impression—just the reverse of the motion picture. This stroboscopic effect will be recalled in one type of gramophone turntable speed indicator and in the effect of viewing the movement of a spoked wheel through a paling fence.

Q: We hear and see quite a lot of clothing fabrics made from nylon and rayon. Briefly, what is the basic process involved?

A. Nylon and rayon fall into a group of artificial fibres as opposed to natural fibres produced from plant, insect or animal life. In the case of rayon, it has a cellulose beginning and when forced under pressure through a "grid" of minute holes, it emerges as a collection of fine filaments. These artificial fibres are spun into thread which is then used to weave the fabric commonly referred to as "rayon."

Nylon is among the most recent discoveries of artificial fibres. It is produced, basically, from water, coal and those gaseous components of the air we breathe. It exhibits properties not found in the rayon and celanese group, it is tough, has no dyeing problems and, as many of us have observed, it possesses a certain degree of elasticity. We hear often of the laundrying facility afforded to male travellers in possession of a "nylon" shirt. When washed, it drys quickly and does not require ironing. Nylon thread has its defence use, too, in the shape of glider tow-lines and fabric and cords for parachutes.

Glass thread is another scientific contribution to the production of fabric. As the term infers, the thread is made from extremely small filaments of molten glass. When woven into a fabric, it possesses many desirable characteristics. It is finding its way into the feminine fashion world in attire ranging from evening gowns to swimming costumes.

Q: What is meant by "pasteurisation" of milk?

A. While excellent as a food, milk is most susceptible to the development of bacteria. It is necessary therefore, to control carefully the methods of milk production and, in some cases, to pass it through a process which greatly reduces the development of bacteria.

Raising the temperature of milk to the boiling point will kill almost all bacteria but the taste of the milk undergoes a change. In the light of this, a Frenchman by the name of Louis Pasteur proved by experiment that it was possible to kill most of the bacteria contained in milk and yet leave the taste of the milk virtually unchanged. It is this process which is referred to as "pasteurisation."

It involves raising the temperature of the milk to 145 degrees (Fahrenheit), holding it at that temperature for about 20 minutes and then quickly cooling it to about 45 degrees where it can be held until ready for delivery and/or consumption.

The range of **UNIVERSITY EQUIPMENT** includes:

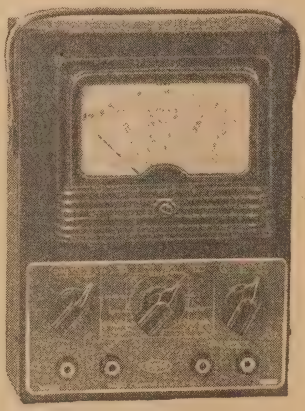
- Signal generators
- Super testers
- Super tracers
- Multimeters
- Current transformers
- Sequential exploders
- Blasting circuit testers
- Electronic timers
- Reverse current relays
- Earth resistance testers
- Meters of all types

UNIVERSITY INSTRUMENTS

FOR EVERY SERVICE BENCH

S.T.B. SIGNAL TRACER

Self-contained and Battery operated, the STB traces a signal right through the Radio Receiver from start to finish. Fault finding is quick and easy. When the probe strikes a faulty section indications are given on both Meter and Speaker. This portable, light and sturdily constructed Instrument, is a definite necessity for fast, speedy and accurate servicing.



MODEL MVA/2 MULTIMETER

Undoubtedly the most popular Multimeter i Australia. A reliable first-class Instrument d signed for either use on the bench or as portable Instrument in the field. It has wide range of A.C. and D.C. volts up to 10 volts, also a wide range of output from mini 10db to plus 45db. D.C. current can be read fro 1 Milliampere in several ranges up to 10 A peres D.C. It is self-contained in its resistan readings which are four separate ranges up a total of 1 megohm. Values as low as .2 of an ohm can be measured on the low Scal Firmly and sturdily built yet pleasing in a pearance, the MVA/2 fills a long-felt wan A.C. and D.C. current ranges can be extended and a leatherette covered Carrying Case is available separately if so desired.

D.C.M. MULTIMETER

This small and easily portable Multimeter is well built and accurate. It provides the following ranges:—D.C. Volts:—10, 50, 250 and 500. D.C. Current:—1, 10, 50 and 250 Milliamperes. D.C. Resistance:—0.1000 and 0.100,000 ohms. It is entirely self-contained and comes complete with Test Leads and Instruction Card.

RADIO & ELECTRONIC TEST EQUIPMENT

University

University Graham Instruments Pty. Ltd., 5 North York St., Sydney Phone: BU3169 (2 lines)

letons in what seemed to be stocene Age gravels.

r. Coon and his assistants had through three gravel and three layers to a depth of about 39

ach gravel layer corresponds to advance of ice and each sand to the retreat of ice during early stages of the earth's his-

r. Coon therefore concludes that humans whose skeletons were nd lived in the third interglacial iod, which would be about 75,000 rs ago.

ven further down, the diggers nd crude flint tools.

he shape of the skeletons has Coon to deduce that a true mo Sapiens (that is to say, man very nearly his present physical pe) is older than so far be- ed.

nthropologists so far theorise t Neanderthal man (50,000 years) is an ancestor of modern man. Coon's find suggests that Homo piens predated Neanderthal man, gesting in turn that Neanderthal n is in fact the ancestor of some n-like ape, but not of man him- f.

Coon reconstructs his 75,000-year- l man as having the following pearance:—

Height, 5ft 8in; body bones, mas- e; feet and hands, big; teeth, long; e orbits, low; chin, very much as is today.

★ ★ ★

V Worries USA

EACHERS and parents are trying to check the damage which tele- sion is doing to Young America. They are alarmed at the never- asing flow of cop-and-robbers pro- ams, the flood of cowboy talk, the luge of crime-is-cute stuff.

These are difficult times for a rent who wants his child to grow p speaking the English language would like his son to take time ff from watching television and o a little homework.

There are parents who have the ourage to turn the TV set off ("Gee, lawm, don't be a heel").

There are even parents so lost o the spirit of neighborliness that hey have refused to buy a tele- ision set.

But, in general, both attitudes re- uire a ruthlessness of mind beyond he ability of the average American ather or mother.

Consequently the burden falls up- n school authorities to try to wedge ome worthwhile programs into that ver-operating magic-box in the iving-room, between the exhorta- ions to collect the tops of cereal ackets and the banging of pistols.

SCHOOL PLAN

The New York State Board of (School) Regents last week filed a plan with the Federal Communica- tions Commission in Washington suggesting a State-wide chain of 11 non-commercial television stations.

The FCC, which decides which stations, commercial or not, shall have the right to start televising, and on which channels, will hold hearings on allocation of educational- television channels during the com- ing summer.

*Important NEWS

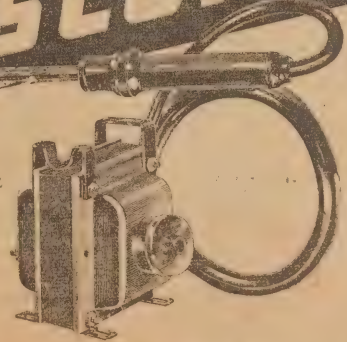
for all
Radio & Electrical Mechanics
Instrument Workers
and all who use
a Soldering Iron

At last soldering has been looked at by scientific eyes. The object? To eliminate time wasted while the iron heats-up, consumption of current while the iron is not in use, danger of human or mechanical damage from parts of the iron not immediately connected with the soldering tip, and to provide safe, low voltage operation from A.C., D.C. or battery operation, or from A.C. mains with transformer.

The result is the now famous Scope Soldering Iron. It heats-up in six seconds, operates from 2.5/6.3 volts A.C./D.C. or from any mains supply with a suitable transformer. It consumes no current when not in use and operates instantly with a light thumb pressure on the switch ring. Beautifully balanced and almost feather-light, there is little chance of burning work or parts of the body as all heat is generated at the soldering tip.

Ask for a demonstration of this really remarkable soldering iron to-day at your local electrical dealer or supplier. Only a demonstration will convince you of Scope's extraordinary efficiency which is equal to that of *other irons rated up to 150 watts.*

SCOPE



TRANSFORMER EXTRA AVAILABLE ON REQUEST

IRON RETAIL PRICE 43/6

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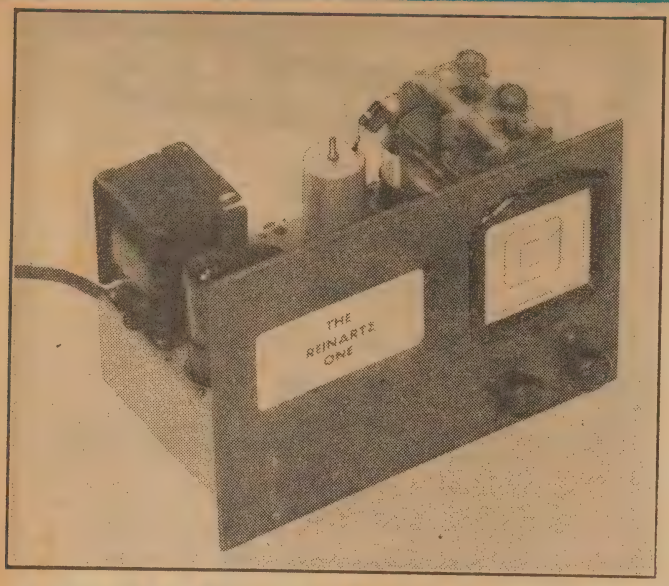
MANUFACTURED BY SCOPE LABORATORIES, MELBOURNE, VICTORIA

S 21 MP



Front view of the Regenerative One showing the location of the new co alongside the valve. The position o the other major components rema unchanged.

As a matter of fact, in most mode coils some attempt is made to tu the primary, using the distribu capacity within the winding, p s that in the aerial. It resonates te winding somewhere near the low f- quency end of the band, at whi end the coupling normally falls o badly. This scheme results in much more even performance ov the whole of the band than wou otherwise be possible.

This brings us to the matter coupling which, in our twin tu circuits, was adjustable. Howev as the efficiency of the circuit is i creased, this factor also becomes le critical and it is possible for t makers to select a value which giv a good all-round performance.

It will be found that there are, necessity, many such compromises radio design for, if every possib variable had to be adjusted each tin a station was tuned in, the set wou

LEARN WHILE YOU BUILD

Rather drastic changes are in the air this month. We are dispensing with our home wound coils in favor of a commercial type. We are using yet another form of detection and adding regeneration. The final result is something really hot.

AT first sight it might appear that we have taken a backward step, for we are reverting to the single-tuned circuit, which we know to have definite limitations in the matter of selectivity. However, we are really only approaching the problem from a different angle and the result will be quite as good or better than the previous circuits.

First a few words about the commercial coil. Compared with the home-made variety it is very much smaller, is fitted with a shield can, and may have a brass screw adjustment protruding from the top or bottom.

NO SERIOUS LOSS

The reduced size is made possible without serious loss of efficiency by using such features as honeycomb windings, litz wire, and iron dust cores. The shield can is fitted to prevent coupling between the coil and other parts of the circuit, particularly other coils, while the screw adjustment varies the position of the iron core within the winding. This provides a means of varying the inductance, and is a most valuable feature when two or more coils have to be set to exactly the same value.

It is usually known as a "Reinartz" coil and has three windings in all, primary, secondary and reaction. As normally used, the secondary is tuned and feeds into the detector, while the primary connects to the aerial. The reaction winding performs a new function which is yet to be discussed. There is also an alternative aerial connection, such as a tapping on the secondary winding, which provides a tighter coupling for use with a small or inefficient aerial.

COUPLING

The primary and secondary are wound side by side, so that signals are transferred from one to the other by magnetic or inductive coupling, exactly as in our twin tune circuits. However, in this case the primary is no longer tuned with a section of the tuning condenser, but the reduced efficiency becomes less of a problem, as our circuits are made efficient in other ways.

by Philip Watson

be equipped with dozens of controls. Not only would this be an intolerable inconvenience but, in most cases, the job would be incorrectly done anyway, resulting in decreased rather than increased efficiency.

In the case of a simple crystal set a few extra adjustments are worthwhile to make the most of the limited signals but, as sets become more efficient, the tendency is to reduce these variables to any absolute minimum.

In order that you may be able to gain a better idea of the effect of regeneration, we suggest that you first build the set without this feature and then, when the set has been given a thorough trial, add the regeneration as indicated by the dotted section of the diagram.

The first thing to be done in the actual construction is to remove the metal plate which was originally used to mount the larger coils. This makes available a hole for the new coil, just to the left of the valve.

CHECK PINS

Before actually mounting the coil check the pin positions as shown on the underchassis diagram, since by locating these correctly the wiring is greatly simplified. It is also necessary to bring a lead out of the top of

e can, and for preference this ould be on the side nearest the lve. If there is no existing hole e can easily be drilled. If there a hole, but on the wrong side, the n should be turned around.

In any case, the coil should be moved from the can and a short ngth of tinned copper wire soldered the "grid" pin (normally No. 4), en bent so that it will pass through e hole in the top of the can when e unit is reassembled. A short ngth of spaghetti insulates the wire here it passes through the can, and is can most easily be added after e assembly.

OLDERING CARE

Now a word or two of warning bout the coil. The material from hich the coil former and base is ade is one of the thermo-plastic mily, often referred to by such ade names as trolitul, &c., and ecause it is a thermo-plastic it is ry easily damaged by the heat from soldering iron. This is a minor sadvantage considering the im-oved insulating properties, but it necessary to be forewarned and ke due care.

The main cause of trouble is a int which will not "take" at the rst application of the iron. Pro-nged heating of the pin will melt e plastic around it and possibly istort the shape of the base.

Before mounting the coil apply a nall quantity of soldering paste to ch pin, and with a clean hot iron uickly tin each one. Speed is the ecret here, and the iron should be emoved immediately the solder ows. If the solder does not flow ithin a few seconds remove the iron nd check for cleanliness, &c., then llow the pin to cool before trying gain.

When you come to solder the leads o the pins make sure that these also re well tinned so that only a mini-num of heat is needed to complete e joint. Be careful not to apply ressure to the pins until they are uite cool.

When actually mounting the coil e very careful not to tighten the uts more than is necessary to hold he can firm, as it is quite easy to ull the mounting studs out of the oft aluminium can.

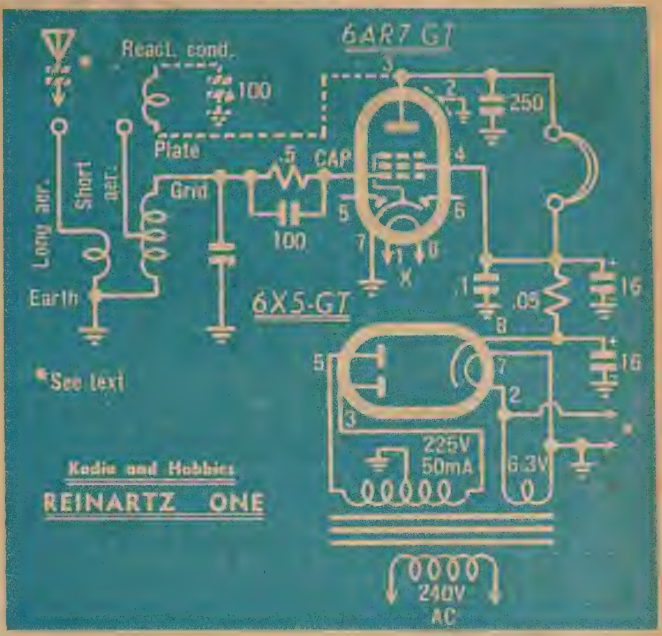
DENTIFICATION

The underchassis wiring is fairly traightforward, being, in fact, some-what simpler than last month's, but here will be several components to e removed, and these should be put side for use in subsequent versions. As we are reverting to a single tuned circuit only the rear section of the gang will be required and a lead rom this passes through a convenient ole in the chassis to the "grid" pin of the coil.

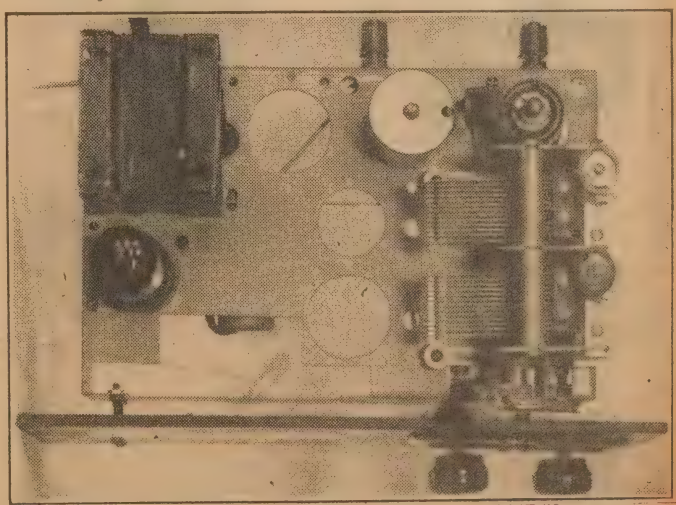
The identification of the coil pins should not present any problem, as we have marked the circuit diagram with the classifications used by the major coil manufacturers. In addition you will find that this information is usually printed on the carton in which the coil is packed, or in some cases an actual circuit diagram is printed on the can. We suggest that you study this part of the circuit carefully in order to get a clear idea of just how the various windings are used.

For the first stage of your construction you will use only three of the six coil pins, ie, one of the aerial pins, the grid pin and the earth pin. For a start it is advisable to use the "long aerial" connection, as the tighter coupling provided by the "short aerial" is likely to make reaction difficult, as well as loading the tuned circuit in the same way as did

CIRCUIT OF THE NEW SET



The circuit is somewhat simpler than last month's. The solid lines show the portion which should be wired first, and the dotted section is the additional wiring of the regeneration circuit.



In this plan view is shown the position of the new coil after the twin coils and the metal plate have been removed.

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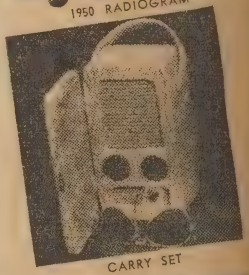
Electronic Parts can provide you with a kit-set for the biggest combination Radiogramophone you'd ever wish to build . . . a multiwave receiver incorporating all the latest developments . . . a receiver the most enthusiastic amateur would be proud to own.



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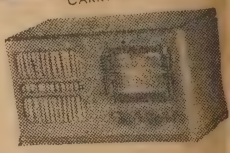

FIRESIDE 5

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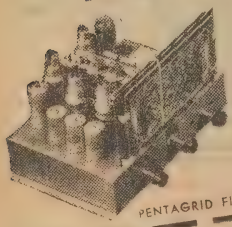
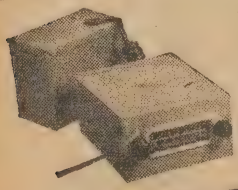
Car radios, portables, luxurious high fidelity receivers . . . small sets for the bedroom or kitchen use . . . A.C. receivers, D.C. receivers, battery sets . . . Electronic Parts have them all in kit form. Every kit is complete to the last nut and bolt . . . every kit is guaranteed. Write for a descriptive price list of the full range of Electronic Parts Kit-Sets. It will be sent without obligation.



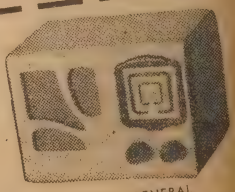
PENTAGRID FIVE

SUPER 8 D/W

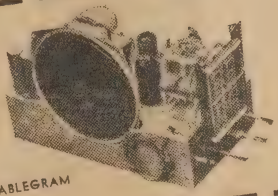


KARSET

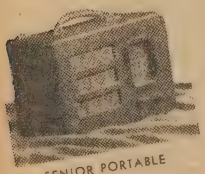
SPRINGTIME PORTABLE



LITTLE GENERAL



TABLEGRAM



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KIT-SET SPECIALISTS

incorrect tapping on your previous
s.

The extension of the grid connec-
n to the top of the can makes
sible a very convenient mounting
the .5 megohm grid leak and the
pf grid condenser. As will be
n from the photographs these are
unted between the grip clip of the
ve and the rigid wire where it
erges from the top of the can.
is resistor-condenser combination
ms what is called a "leaky grid"
ector circuit, by far the most
ular arrangement for small one
two-valve sets.

REEN BYPASS

The only other major component is
1 mfd condenser from the screen
the chassis, and the position of this
n be seen clearly in the under-
ssis photographs. Otherwise the
nections to the phone terminals
d the screen pin remain unaltered,
does the entire wiring of the
wer supply.

With this much of the wiring com-
ted you will be ready to give the
its first test, and you should have
difficulty in tuning in most of
tropolitan stations from a location
ywhere in the city and suburbs.
owever, in most cases there will be
rious interference between at least
me of the stations, particularly if
e aerial pick-up is good enough to
ve reasonable results from the
eaker ones.

This is where a single tuned cir-
it calls for some compromise, it
ing necessary to choose between
n aerial length which will give
tisfactory reception of weak sta-
ons and one which will separate the
ore powerful ones. Although care-
l selection of length can effect con-
derable improvement, it is seldom
at both requirements can be com-
letely satisfied, and the problem
sually resolves itself into a selection
favor of a preferred station.

ERIES CONDENSERS

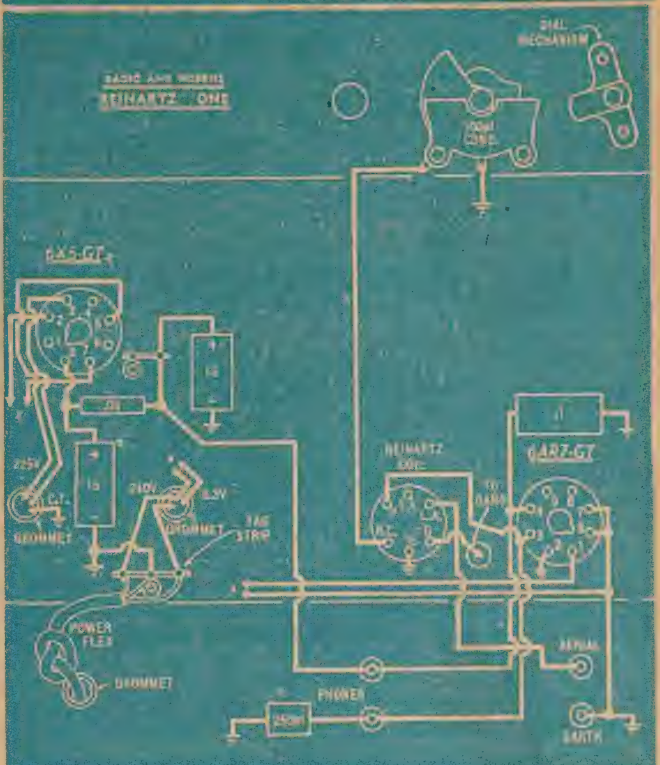
Incidentally, there is no need to
ash out to the aerial armed with a
air of wire cutters, with the idea of
arving off a few feet at a time until
ou get the results you want. It is
uch easier and just as effective to
nsert small value condensers in
eries with the aerial lead (shown
lotted in the circuit).

As a matter of fact, we had to
esort to this procedure with our own
aboratory aerial, which, when direct-
y coupled, produced some very
ueer loading effects at the high fre-
uency end of the dial. We event-
ally obtained best results with a
50 pf condenser as a coupling unit.

The important thing is to note
arefully the performance of the set
n its present form, with as many
different aerials or degrees of coup-
ling as are available, so that you will
have a basis for comparison when
you add the regeneration circuit.

The addition of this section calls
for only a few additional connections,
but there are some points to be con-
sidered in the mounting of the rege-
neration control, in this case a small

WIRING DIAGRAM OF THE SET



Comparing this diagram with last month's will help in making the few alterations necessary. The coil pin positions may vary with different makes and should be checked carefully.

variable condenser having a maxi-
mum capacity around 100 pf.

MOUNTING

Mounting this unit presents some-
thing of a problem. Most types have
too short a shaft to suit our present
panel mounting arrangement, and it
will be necessary to make use of
some kind of shaft extension. These
are readily available from radio sup-
pliers, the type required in this case
being known as a "¼" to ¼" exten-
sion shaft."

It will probably be found that,
while the condenser shaft is too short
to allow a knob to be fitted, it is too
long to enable the extension to be
fitted. It is not advisable to cut this
shaft, as it really consists of a bush
driven over a smaller shaft, and the
whole condenser assembly is in dan-
ger of falling apart. We overcame
the difficulty by fitting washers be-
hind the front of the chassis to move
the condenser back as far as pos-
sible, and then increasing the hole
depth in the extension.

In many cases this may have to
be drilled out, but in our case the
shaft was a drive fit in the coupling
and we were able to force it forward
the required distance with the aid
of a punch, hammer and vice. This
enabled the set-screws to be located
behind the panel, but it was neces-
sary to enlarge the hole in the panel
to accommodate the larger part of
the extension.

While there is no objection to this
where a panel has been fitted, it is
not advisable to alter a cabinet in
this way, as this control is only tem-
porary. If you have already fitted a
cabinet, it might be advisable to put
it one side for this and next month's
version.

OSCILLATION

With the regeneration circuit com-
plete, you are ready to make another
test. Start with the control in the
minimum position (plates out of
mesh) and tune in a signal as be-
fore. Now advance the control
slowly and the signals should increase
in strength until the set starts to
squeal or distortion occurs.

In either case, it indicates that the
tuned circuit is oscillating, and is a
condition to be avoided, not only
because the set will not perform at
its best, but also because it will
cause interference with neighboring
receivers. By retarding the control
slightly you will find a position just

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All Brand New and Guaranteed.

0-1 A. R.F. Plug-in type ..	17/6
0-5 mA. 2" square	25/-
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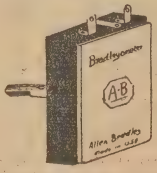

The best potentiometer at any price. The graphite and mica disc type element ensures long life. The moving contact is gear driven and very smooth. Two sizes only—0.25 and 0.1 meg.

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Brand new, ex-Disposals:—

EF50. R.F. Pentode	15/-
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6H6. Metal Duo-diode	5/-
6SH7. Metal R.F. Pentode	5/-
7193. U.H.F. Triode	5/-
1K7G. 2v Diode-pentode	5/-

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BULGIN TOGGLE SWITCHES

S.P.S.T., with "On-Off" indicator plates	3/3
MICA CONDENSERS, 0.01 mF. Standard type for 500v., ...	1/6
1000v. type	3/-
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EDDYSTONE Flexible Couplings for ¼in. shaft	2/6
EF50 SOCKETS. Best quality, grey ceramic insulation	2/-
EDDYSTONE Midget Split-Stator Condensers. 100 mmF. with ceramic insulation	5/-
MIDGET CONDENSERS. 50 mmF. ceramic end plates	3/-
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MORSE KEYS. Brass with bakelite case	3/-

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Gang Condensers. Polar 2-gang miniature type	15/-
Condensers. 0.002 mF. for 900v RMS working	1/-
Cables for Noll Sets. Per set of 4 cables	15/-

No. 11.

HARTLEY TURNER

This is your last opportunity to secure the famous Hartley Turner High Fidelity Speaker at the old price of £16/10/-. New stocks are expected to sell at over £22.

RELAYS

Our range of relays is now very extensive. There are too many types to list. Send your order specifying contact arrangement and coil resistance and a suitable type will be supplied.

The following are similar to the illustration.

250 plus 250 ohms 4-pole, single throw	7/6
250 plus 250 ohms 2-pole, single throw	6/6
15,000 ohms 2-pole, double throw	12/6

(Postage 9d)

SWITCHES

Popular wafer type switches.

1-pole, 6-position, 1-bank	3/6
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6-pole, 2-position, 1-bank	5/6
2-pole, 4-position, 2-bank	7/6

(One ceramic bank.)
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No. 3 Carbon Hand Microphones. Used but in perfect order	5/-
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Army Headphones. Low resistance, complete with cords and headbands. New	8/6
Dynamic Headphones. 90 ohms impedance. New	15/6
Phone Plugs. PMG type. New ..	3/-
Phone Plugs. Army type. Used ..	6d

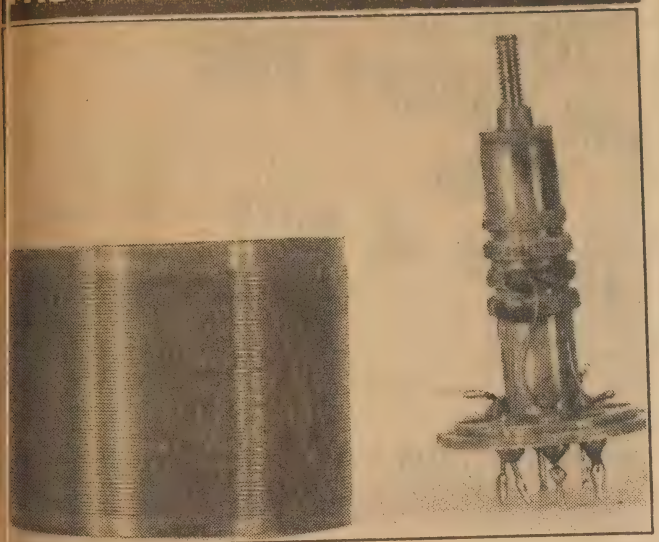
(Postage extra.)

Please allow sufficient for postage. Any surplus remitted will be refunded with goods.

PRICE'S RADIO

5 & 6 Angel Place - - - SYDNEY

THE OLD AND NEW TUNING COILS



This picture compares the home-wound coil and the commercial variety, the most obvious difference being that of size. However, there are other important points which are discussed in the text.

elow the point of oscillation where ie best possible results will be ob-ained.

The operation of the new control nay at first seem a little strange, but few minutes will give you the hang f it, and you will find the perform-nce of the set to be vastly improved, oth in gain and selectivity. One mportant point to realise is that the djustment of the regeneration con-rol has a slight effect on the tuning ircuit, so that this should always e checked after the regeneration has een adjusted.

BETTER SELECTIVITY

In most cases it should now be possible both to separate the strong stations and to receive the weaker ones. In some difficult locations best results will still be obtained with a careful selection of aerial length or coupling.

Now just what is the reason behind this improved performance? How is it that the addition of such a simple piece of circuitry can have such a marked effect?

It will be probably easier to grasp this principle if it is realised that there are various losses in the circuit between the aerial and the grid of the valve, consisting of RF resistance, mainly within the coil, and those due to the detector taking a certain amount of power from the incoming signal.

If these losses could be eliminated, or in some way overcome, it is obvious that the performance of the set must improve. While there does not seem to be much hope that we will ever produce coils, &c., which are completely free from losses, we do achieve essentially the same effect by means of regeneration.

In the plate circuit of our valve are both audio frequency and radio frequency signals which have been amplified by the valve itself. The audio signals are required in the headphones, but until now the amplified RF signals have been of no use.

But these signals, although amplified, are identical with those being picked up by the aerial, so why not divert them back to the grid circuit, where they can assist the incoming signals to overcome the various circuit losses?

We do this by passing them through the reaction winding which, being wound alongside the grid coil, may be regarded as inductively coupled to it. We control the amount of signal work fed back by means of the small variable condenser connected between the winding and earth.

When the signals induced back in the grid winding are greater than the losses in the circuit, any oscillation which commences in this circuit will continue indefinitely. This is the condition which produces the horrible squeals and distortion which occur when the reaction control is advanced too far.

REACTION POINT

This simply means that we cannot very well operate the set under conditions where all losses have been overcome, but we can operate it at a point just below this condition, where very few losses remain. Thus the secret of good operation is to bring this control as near as possible to the "no loss" point, without it actually reaching it.

While the skill of the operator is important in this regard, it is also essential that the control be quite

17 YEARS OF LEADERSHIP

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Ducon Motor start capacitors are in use throughout the Commonwealth and have been so for many years. They are used in every capacitor start motor manufactured in Australia.

The splendid performance of this new Ducon Motor start capacitor is one more illustration of Ducon's 17 years of leadership in the Capacitor field. Your good judgment is confirmed when you specify Ducon for all exacting capacitor applications.

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DUCON Capacitors

Ducon Condenser Ltd.

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It's John MARTIN'S PAGE for the 20 and 40 BOYS

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See John Martin's special amateur window which includes amongst other gear the new *Jonmar* 100 watt transformer employing Eddystone, *Belling Lee*, Bulgin, *Trimax* and Labgear components.

BARGAIN COUNTER

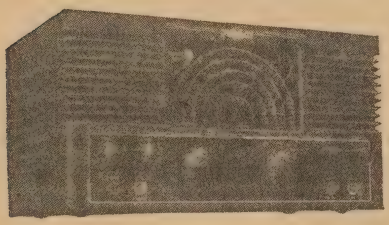
Most popular spot in our Radio Division showroom at 116 Clarence Street is the newly installed *bargain counter*. Pop in whenever you're passing and *look them over*, there's sure to be something you can't afford to miss at *the special prices*.

JONMAR KITSETS

If you're building another set for around the house you won't do better than the S & S (just Screw & Solder) *Jonmar* kitsets. These include the R & H advance, *a new 'gram*, the junior and *senior* portables and other new designs. Write *or call* for full particulars.

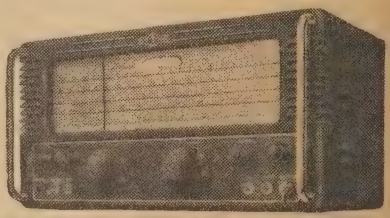
EDDYSTONE—the amateur's own set

You won't match the performance *and selectivity* of these designed ham commutors by *Eddystone*. They're assembled with all the care and careful fitting of a fine watch. Write *or call* for folders on all *Eddystone* models.



EDDYSTONE 8 TUBER

The 740 is suitable for both *professional* and amateur requirements. An 8-tube superhet with a hitherto *unequalled signal-to-noise* ratio of outstanding performance over a big range of frequencies. Gear driven; bandspread opens each range to 60". 110 and 240 volt and a *6 volt battery* operation available. £81/8/8.



11 TUBE DOUBLE SUPERHET.

The new Eddystone "750" Receiver combines high selectivity and sensitivity with excellent signal-to-noise ratio. The tuning range is *continuous from* 32 Mc/s. to 480 Kc/s.

The ingenious mechanical bandspread mechanism gives an almost linear scale equivalent to about *32 feet* on *each tuning range*.

Separate RF, IF and AF gain controls combined with selectivity *variable over wide limits*, ensure maximum performance under all conditions of operation. £128/7/10

JOHN MARTIN PTY. LTD.

Radio Components: 116-118 Clarence Street, Sydney.

Head Office: 93 York Street, Sydney.

ooth in operation. This does not fer so much to the mechanical side, it does to the electrical, it being cessary to so select values that e point of oscillation can be ap-oached slowly, without any sug-stion of a sudden change of con-tions, which makes it impossible to e the control correctly.

So far, we have endeavored to ex-ain only the improvement in sen-tivity due to regeneration but it ill be obvious that the selectivity is also been considerably improved. ne reason for this is not hard to llow.

EACTION WINDING

Those RF signals which appear in e plate circuit of the valve have ready been tuned so that the want-d signals are loudest. When these e fed back to the grid it is easy see that the improved efficiency

PARTS LIST

1 Reinartz coil
1 100 pf midget variable condenser
1 .1 mfd 400 volt paper condenser
1 ¼" to ½" extension shaft
You should have these parts
A review of previous parts lists in this series.
(* No longer required.)
* 1 Base board 6" x 5½" x ¾"
* 1 Front panel 7" x 5½".
1 2 gang condenser (Stromberg Carlson or AWA).
* 1 3" length of 2" diameter coil former
* 1 Adjustable crystal detector with crystal or
* 1 GEX33 germanium diode
1 Pair high impedance headphones
4 Terminals
1 .001 mfd condenser
1 Pointer knob
1 Little General chassis
1 Dial calibrated to suit gang. (Type MK/17A or similar.)
2 Trimmer condensers
1 Front panel 10" x 7" (Masonite &c.)
* 5 Strips of punching bakelite 2½" x ½" x 1/16"
2 Small round knobs
* Small block of wood 2½" x ¾" square
Coil former and winding similar to existing coil
Small rubber grommet for dial drive
1 6AR7-GT valve
1 Type PF 201 transformer (or similar)
* 1 9 volt "C" battery
1 3000 ohm resistor ½ or 1 watt
1 .1 megohm potentiometer
1 25 mfd, 40 volt electrolytic condenser
1 Octal socket
1 Grid clip
1 3 tag terminal strip
1 6X5 valve
1 Octal socket
2 16 mfd 525V electrolytic condensers
1 .05 meg 1 watt resistor
1 .5 meg, 1 or ½ watt resistor
1 250 ohm, 1 watt resistor
1 .01 mfd 600V condenser
1 .02 mfd 600V condenser
1 100 pf mica condenser
Grommets, power flex, hookup wire, solder lugs, spaghetti, nuts and bolts &c.

(Continued on Page 79)

The result of exacting research and design, R.E.L. were rewarded with the ultimate

ELECTRONIC MULTIMETER AND PROBE

incorporating VACUUM TUBE VOLTMETER

£29½ PLUS TAX

Terms available from £10 deposit

This instrument has been developed by R.E.L. to meet the growing demand for an instrument of laboratory sensitivity built in a robust and portable form, for use in conjunction with electronic and other apparatus where it is imperative that the instrument should present a negligible loading factor upon the circuit under test.

- Designed specially for F.M. and Television work.
- Thirty complete ranges (including D.C. x 3 range).
- Independent internal and external diodes for A.C. operation, covering all frequencies from 50 cycles to U.H.F. spectrum.
- The thermionic circuit gives higher meter sensitivity to a specially designed durable moving coil movement (fitted with robust pointer) which it is almost impossible to damage by overload.
- High quality Probe, insulated throughout with Polystyrene.
- Uses one per cent. tol. precision ceramic divider Resistors.
- Clear direct reading two coloured meter scale.
- Contains four valves of the latest type.
- Electronic A.C. circuit, no current drawing metal rectifiers used.
- Electronic Ohmmeter ranges from 0.2 ohms to 1,000 megohms in five steps.
- Input impedance of over 10 megohms.
- Modern slope panel styling.
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High Resistance D.C. Voltmeter
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with internal diode or external probe, 0 to 3v, 0 to 10v, 0 to 30v, 0 to 100v, 0 to 600v.

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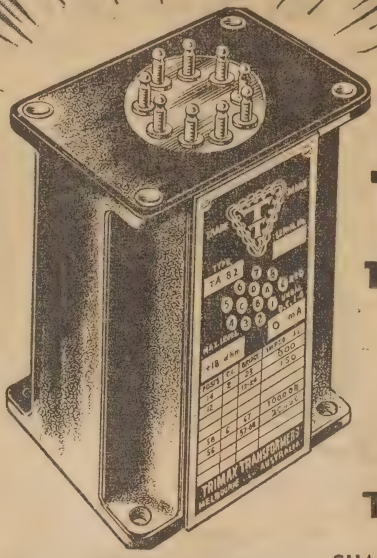

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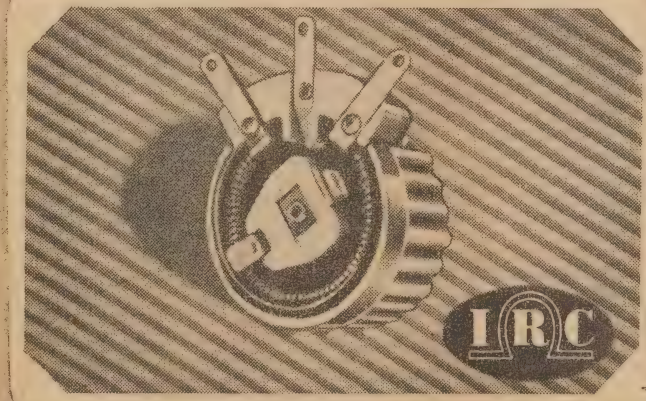

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A COURSE IN TELEVISION

PART 26—POWER SUPPLY DESIGN

Every television receiver contains at least two power supplies. The conventional "HT" supply delivers approximately 300 volts for the tuning system, amplifiers and auxiliary circuits, while the so-called "EHT" supply delivers several thousand volts for the picture tube. The purpose of this and subsequent articles is mainly to discuss the types and designs of EHT supplies.

THE conventional HT supply can be described briefly at the outset and then dismissed. It is basically similar to the power supply in a conventional broadcast receiver, but there are special requirements which have led to variations in design practice.

The most obvious point of difference arises from the number of valves and stages in a complete television receiver. The sound channel alone is equivalent, in many cases, to a complete broadcast set. To this must be added the video channel, the video output circuits, the sweep and amplifier circuits and, in some cases, the demands made by a dependant EHT supply.

HEAVY CURRENT

Added together all this may account for a total drain of several hundred milliamps and it is commonplace to find two heavy duty receiver-type rectifiers operating in parallel.

A current drain of this order also presents special filtering difficulties, because the net load impedance on the supply assumes a relatively low value. The filter condensers tend to discharge rapidly between charging pulses, thereby producing a high ripple content.

For this reason the filter condenser values are normally much higher than in a conventional receiver supply. Figures of between 40 and 100 mfd are commonplace both in the main filter and in subsidiary decoupling networks. The filter choke must exhibit high inductance, high current capacity and low DC resistance.

SPECIAL VALVES

For the sake of cheapness and overall size there is an obvious point in using electrolytic filter condensers, but the problem arises of maintaining the peak voltages, particularly at the rectifier output, within safe limits. This leads to a very practical difficulty in using output valves which might require upwards of 400 volts effective at the plates.

The tendency has therefore been to favor and develop power valves which will deliver adequate output from the audio, video and sweep circuits with no more than about 300 volts on the plates. Even if such valves do draw somewhat heavier current it is still preferable to running into voltage figures which would entail the use of expensive and bulky paper condensers.

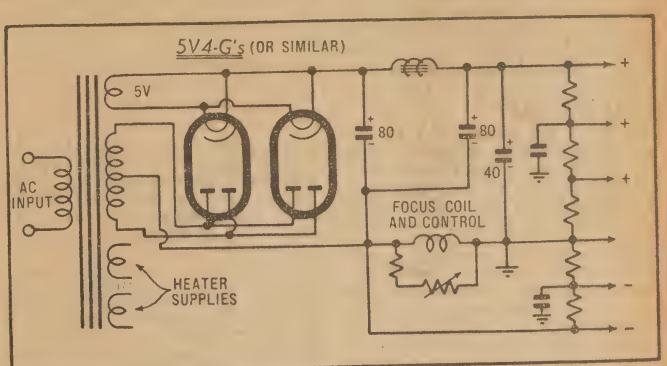


Figure 1. A typical high-tension supply for a television receiver. Note the parallel rectifiers to handle the current and the large filter condenser values. Adequate heater supplies must also be available.

The degree of filtering ultimately achieved must be adequate for low hum level in the sound channel. The video channel must be protected both from an excessive hum level and from low frequency pulses fed back from the sound channel through the HT line. Such effects produce moving bars of light or shadow across the face of the picture.

Figure 1 shows a typical HT supply for a television receiver. Points of note, as already mentioned, are the twin rectifier valves and the unusually large filter condenser values.

The negative return to earth, as in common practice, is through the focusing coil, the amount of current through the coil being controlled by a variable shunt. A negative potential is available across this return circuit for intensity control, grid bias and such-like.

DIVIDER SYSTEMS

A divider network is shown across both the positive and the negative output circuits, serving to divide the potentials as necessary and also to give decoupling in association with suitable condensers.

It follows that the power transformer must be of liberal dimensions to supply the considerable HT demands as well as the large number of heaters. Even allowing for special low-flux design such a transformer is likely to radiate an extensive magnetic field and it must be kept well away from the picture tube "gun." Magnetic shielding offers only a partial solution to this problem.

Various US manufacturers have adopted the alternative approach of eliminating the power transformer altogether and feeding the mains input directly to a bank of heavy duty metal rectifiers operating in a voltage doubler circuit.

This eliminates the filament drain of at least two rectifiers while many of the remaining heaters are commonly operated from a series network. As a result, the bulky power transformer gives way to a relatively small filament transformer operating those valves which cannot conveniently be connected into the series network.

LOCAL CONDITIONS

This approach is popular in the US and is in line with accepted practice for their AC-DC receivers. However, it is not an attractive approach where the mains voltage is greater than 110 because of the greatly increased risk of shock from contact with exposed metalwork.

It is therefore likely that local television receivers will retain the conventional power transformer approach, though some designers may prefer to use two or more smaller supplies rather than a single heavy duty supply.

The points made in respect to the normal HT supply contrast vividly with the considerations governing the EHT—or "extra high tension" supply.

In this case, the voltage required will lie between about 2000 for a very small tube and as high as 30,000 volts in the other extreme. These voltages would commonly be referred to as 2 or 30 "KV" respectively. A more typical figure for a domestic receiver is around 7 KV (or 7 kilovolts).

Fortunately, the current drain on the supply is very small, being only a matter of microamps in most cases for the tube electrodes. However, some kind of voltage dividing system is necessary to graduate the operating potentials for the "gun," and this imposes a load of its own.

As a rule, the total drain of the tube and divider network approximates one milliamp, although, for special reasons, some designers may elect to make it higher or lower than this figure.

VOLTAGES VARY

There is not much point at this stage in pausing to examine divider networks in detail, since the number of anodes in the gun and their operating potentials depend entirely on the choice of tube. It is sufficient to note that some tubes have as many as three anodes in the gun, the potential of one being variable for adjustment to the focus. Other tubes may only have a single anode, the focus being adjusted by a magnetic focusing coil, as already described.

The divider network is commonly made up from a string of high value resistors—one megohm or larger—which impose only a small load on the EHT supply.

The divider network serves very usefully to discharge the filter condensers, when the receiver is switched off, thereby eliminating a potential source of shock.

A simple receiver using electrostatic deflection might well have the positive end of the network near earth potential, as is common practice with oscillographs. Chief purpose of this is to minimise the potential across coupling condensers to the deflector plates. With magnetic deflection the point does not arise, and it is then usually more convenient to keep the heater circuit of the picture tube close to earth potential.

TYPES OF SUPPLY

The supply itself can take various basic forms, as under: (1) High voltage 50-cycle transformer and rectifier; (2) 50-cycle voltage multiplying system; (3) RF power supply; and (4) flyback power supply. While present practice favors the flyback system, each of the others is sufficiently important to warrant special mention.

The straight-forward 50-cycle supply was more or less standard in early television receivers, probably because it was conventional and convenient enough for moderate figures of EHT. The basic circuit, for purposes of discussion, is shown in figure 2a.

In conformity with usual CRO practice, a half-wave circuit is assumed, its particular advantage being that only a single untapped winding is required, having a peak voltage

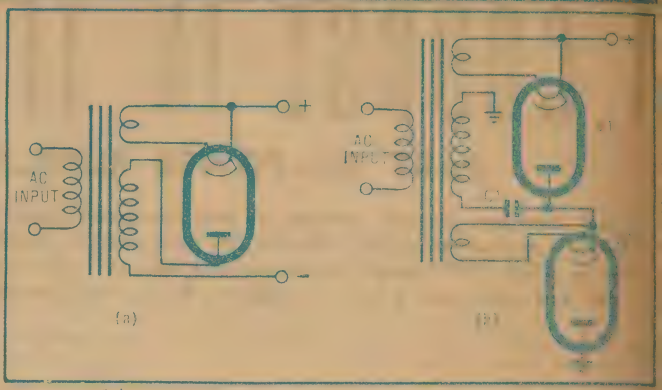


Figure 2. Illustrating (a) a conventional 50-cycle half-wave supply and (b) a voltage doubling system. Special high-voltage metal rectifiers are sometimes used in voltage multipliers.

rating just a little higher than the required d-c output. A full-wave circuit would require twice the overall voltage and an additional rectifier valve, both representing extra expense and complication.

The full-wave circuit would have the advantage of easier filtering, but the problems are minimised anyway in view of the very small current drain on the supply. Needless to say, the rectifier valve itself and all high-voltage portions of the circuit must be designed to withstand the high peak potentials.

VOLTAGE MULTIPLIER

An alternative approach is represented by voltage multiplying circuits, a simple doubling arrangement being shown in figure 2b. Its operation is as follows:

When the non-grounded end of the secondary swings negative with respect to earth, the lower rectifier V2 conducts and charges C1 to near the peak value of the AC input. The polarity of the charge is such that the end of the C1 connecting to the rectifier is positive.

The charge is retained during the following half-cycle which makes the non-grounded end of the secondary positive. The total voltage applied to the anode of V1 is therefore equal to the sum of the peak voltage across the winding and the charge held by C1. When V1 conducts, therefore, its cathode assumes a potential which approaches twice the AC input from the transformer.

Voltage multiplying circuits of this type, therefore, reduce the secondary voltage requirements from the EHT transformer but necessitate additional rectifiers and individual, well-insulated filament windings.

An interesting device which partially overcomes this difficulty is a special assembly of high-voltage metal rectifiers which are stacked and interconnected to act as a multi-stage voltage multiplier. The transformer secondary input is connected to appropriate points and the high potential DC is immediately available from a high-voltage terminal.

In the matter of filtering, early practice was simply to connect a single fairly large condenser across the output of the rectifier system. A value of 1 mfd was popular.

More recent practice has been to

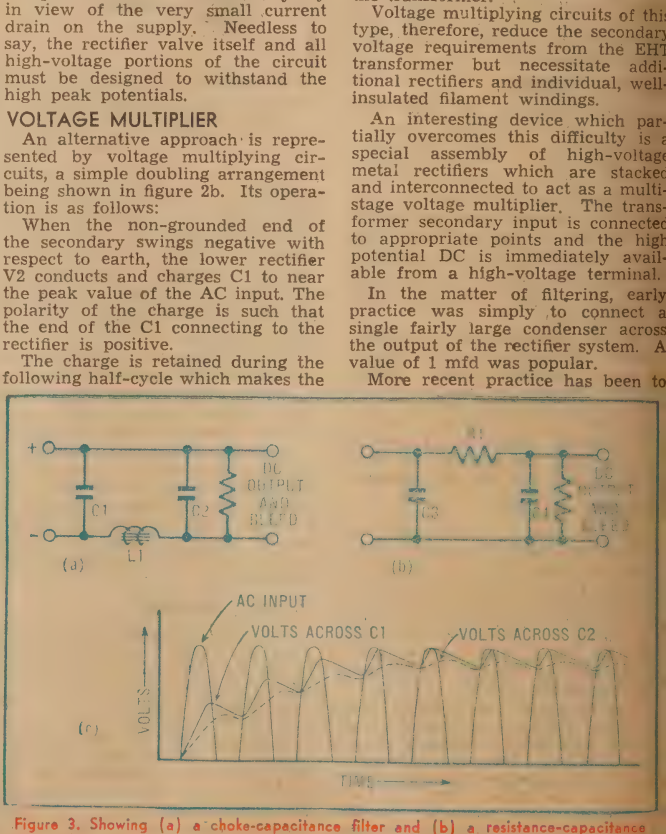


Figure 3. Showing (a) a choke-capacitance filter and (b) a resistance-capacitance filter. The action of the filter is illustrated in (c) showing the progress from half-wave pulses to the voltage across the second condenser (dotted).

e series as well as shunt impedance d to employ two much smaller ndensers in place of a single large e.

Thus by including a 1500 henry oke in the filter—preferably on the gative or earthy side—two filter ndensers of only about .05 mfd cre found to give adequate filtering. More simply, the choke has given ace to a resistor in the positive lead ith filter condensers of the same der.

Figure 3c illustrates roughly the tion of the filter. The useful input the half-wave rectifier is a series AC input pulses, as shown. During e initial pulse the rectifier par- ally charges C1, the charge tending diminish during the interval when ere is no input.

TEADY STATE

The loss of voltage is small com- ared with the original charge, how- ver, so that succeeding input cycles ltimately charge the capacitor to ear the peak value of the AC input. he normal output is a sawtooth oltage, shown by the solid line, and ne charge during the AC input peak ust balances the discharge during ne interval when the rectifier is not onducting.

The amplitude of the sawtooth aveform, and therefore the degree f ripple on the supply, is a function f input frequency, the condenser alue and finally the load current hich determines the discharge rate. s already intimated, by using a arge value for C1 and keeping the oad current small, it is possible to chieve virtually complete filtering vith a single condenser and this is ommon practice in laboratory scillographs.

For reasons which shall be dis- ussed later there are objections to sing a single large input condenser n a television receiver and it must e assumed that there will be con- iderable ripple left across C1. As a esult, additional filtering will be equired, involving a choke, or more ommonly a resistor.

The use of a resistance filter may ppear to be strange at first glance, ut the current drain is so low that it is possible to use quite large values —upwards of 0.1 meg—without intro- ducing too serious a loss of EHT voltage.

ACTION OF FILTER

The function of the resistor (or choke) and the second filter con- denser is suggested by the dotted line in figure 3c.

The time constant of the two com- ponents prevents the sharp rise in voltage during the charging period, while the additional storage effect reduces the slope of the discharge curve. The final result is a much reduced ripple content and it is a matter of design to choose compon- ents which are adequate for the re- quirements of the particular receiver.

The same type of filter can be used for conventional half-wave supplies or voltage multipliers, as in figure 2A or 2B, since the input wave-form and frequency is essentially similar.

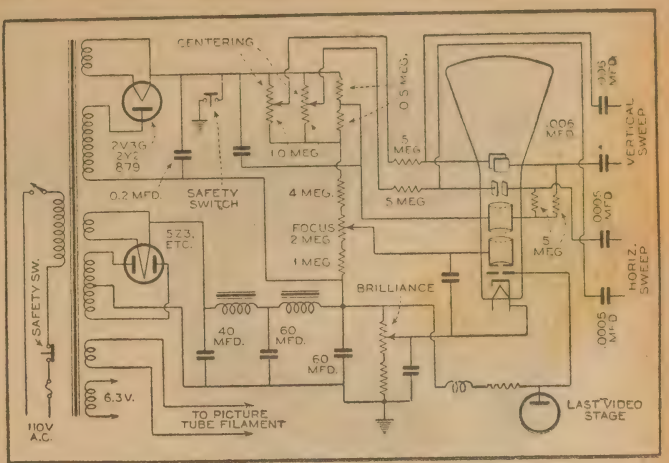


Figure 4. Included as a matter of interest, this circuit shows the complete power supply and deflection arrangements in an early American receiver using the 1802 (or 5BP1) electrostatically focused tube. This type of circuit might well be popular locally for simple, home-made receivers.

As mentioned earlier, the efficiency of a filter is closely related to the ripple frequency and, in practice, much larger values of filter con- denser are required for a 50-cycle input than would be required with higher input frequencies. This in- volves additional expense and, con- sidered together with the cost of a special high voltage power trans- former, constitutes one reason why 50-cycle supplies are less popular than once they were.

An equally important reason, how- ever, is bound up in the question of safety. While the cabinet of a tele- vision receiver may carry warnings about high voltage it is obviously desirable to protect the public—and service-men as well — against the risk of fatal shock.

Two points must be borne in mind: (1) The maximum current which can be sustained by the supply on a low resistance load and (2) the amount of energy which can be dis- charged from the filter condensers into a low resistance load.

SAFETY ANGLE

Proper attention to these matters offers a degree of safety for anyone who may have to work on the set after shorting out the interlocking safety switches on the cabinet.

The first consideration presents no great problem because in most cases the danger region from a sustained current through the body lies above 100 milliamps. Since the normal load current on the supply is only one or two milliamps it is not diffi- cult to arrange the impedance of the rectifier, transformer and the filter to be of such an order that it will not pass this amount of current, even on short circuit.

In practice it is not difficult to limit the short-circuit current to about 20 milliamps, which is no more than merely unpleasant. One popular safety measure is to include a resistor of up to 0.1 meg in series with the rectifier plate lead, thereby increas- ing drastically the apparent im- pedance of the supply.

CHARGED CONDENSERS

The more potent hazard to life is likely to be charge-stored in the filter condensers which should not exceed one joule. This quantity can be related to voltage and capacitance fairly simply and it is found that the maximum "safe" capacitance diminishes rapidly as the voltage rises.

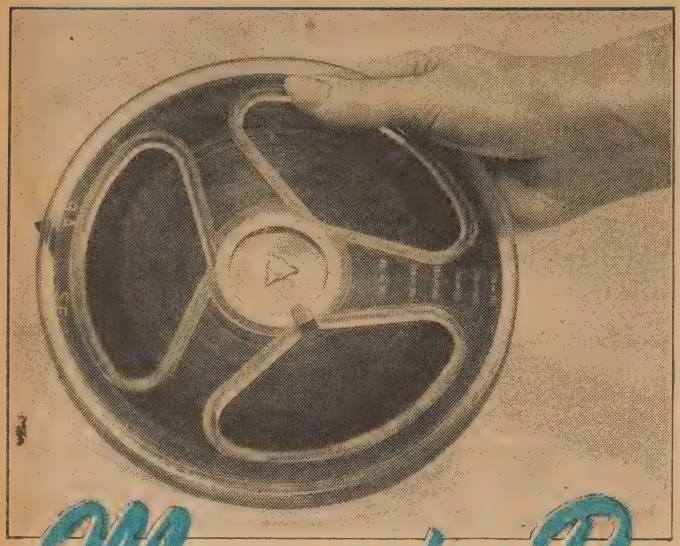
With an EHT of 1000 volts, for example, the total filter capacitance can be as high as 2mfd. This drops to 0.08 mfd at 5000 volts and 0.0 mfd at 10,000 volts. There is thu little margin between maximum value permissible for safety and th minimum value necessary for goo filtering.

Considerations of this nature hav led to the widespread adoption of R and flyback type power supplie which will be discussed in subse quent articles.

EXPERIENCE has shown tha even brief overheating wi cause a considerable change in th value of small carbon resistor Furthermore, the change is likely t be permanent.

If the overheating is due to th use of a resistor with an inadequa wattage rating the cure is obvio but the same trouble can be caus by overheating during the solderi operation.

One method of overcoming th problem is to use a pair of lon nosed pliers as a thermal sho absorber. Simply grip the lead wi the pliers and hold it firmly un the solder joint has had time cool.



Approximately 1200 feet of tape on a 7-inch diameter plastic spool. Running at 7½ inches per second, and used on a twin-track machine, this tape will carry an hour's recording.

Magnetic Recording

Over the past few months, tremendous interest has built up around the subject of magnetic and particularly tape, recording. We plan, therefore, to present a series of articles beginning with the general application and theory and culminating later in practical equipment.

IN principle, this type of recording involves drawing a magnetically sensitive wire or ribbon between the poles of an electromagnet. The magnet is energised by the audio frequency currents to be recorded and a magnetic pattern is produced in the wire or tape.

To playback the recording, the medium is simply drawn again past the poles of a similar magnet and the fields in the medium induce signal currents in the magnet winding, similar to those which originally produced the recording. They are made audible directly by means of headphones or by amplification, in the normal way.

OLD IDEA

Magnetic recording is not by any means new. The basic idea can be traced back at least to 1888, while the Danish engineer, Valdemar Poulsen, produced a practical recorder and playback system just before the turn of the century.

By the then current standards, Poulsen's recorder worked extremely well but the efforts of Poulsen and others who followed were frustrated by the lack of an electronic amplifier capable of operating a loudspeaker. This lack, which remained for the next 25 years, restricted all forms of magnetic recording to earphone output during which time the gramophone disc technique became firmly established.

There was some difficulty also with noise level and with a form of distortion which persisted, despite efforts to overcome it. Even so, magnetic recording was brought to a stage where it could quite well have been used for office dictation machines and other special purposes.

The reasons for its non-adoption at this stage appear to be commercial rather than technical in character.

In 1927 came the important discovery that both distortion and noise could largely be eliminated by the so-called "a-c biasing" method. Basically, it involved subjecting the recording medium high-frequency magnetic field simultaneously with the audio signal.

This fundamental improvement, coupled with the availability of electronic amplifiers and loudspeakers, now provided a means whereby programs could be recorded and played back with excellent fidelity and without interruption for quite lengthy periods. In fact, the only limitation on playing time was in the amount of wire or tape which could conveniently be stored on a single drum.

ERASING

It was also appreciated that, by subjecting the wire or tape, at a later date, to a strong permanent magnet field, or to a strong high frequency field, the signal could be wiped off at will and the medium used again for another recording. The attractions of the scheme were obvious and it soon began to find application in broadcasting work.

Most of the early machines operated at the considerable speed of 7ft per second, which posed severe problems of handling and wear. Even so, by using wire of diameter about .008 inch, programs of up to an hour's duration could successfully be recorded.

As was only to be expected, the fine recording wire was generally preferred to steel tape, which gradually dropped out of the picture. Rapid development in wire technique followed the wartime demand for a medium combining a long-playing time with the greatest possible portability.

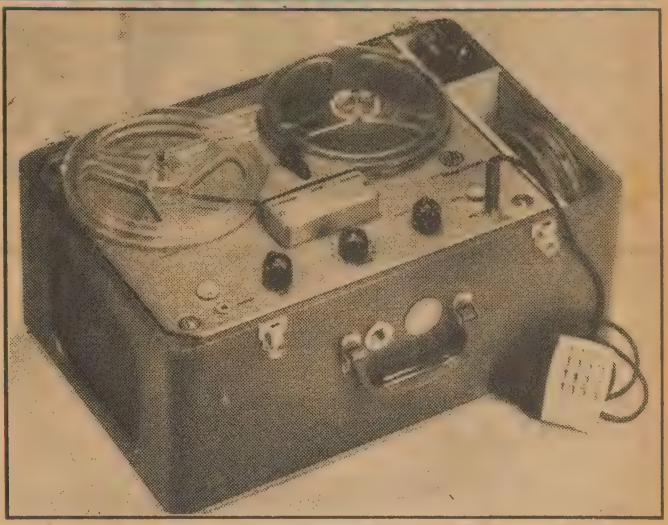
The machines were scaled down along with the wire diameter and wire speed, till something approaching pocket-size equipment became feasible, at least for speech recording.

WIRE RECORDERS

On the other hand somewhat larger wire recorders were developed, which were capable of recording and playing back musical programs with quality on a par with gramophone discs and often exhibiting lower background noise.

Many such recorders have been released on world markets and many readers will have seen them in use in this country. Their capabilities are frequently misjudged, however, because they are used to record items under conditions so unfavorable that no other form of recording could be attempted.

A TYPICAL TAPE RECORDER



A typical Australian-made tape recorder which has the twin-track feature. Music and speech recordings can be made, using the microphone shown, then played back immediately or erased at will. Output can also be taken from the voice-coil of a loudspeaker attached to a radio set.

modern portable wire recorder rates at a wire speed of between 2 and 5ft per second. It uses a e having a diameter of about .004 h and will concentrate a program up to an hour's duration on a ol less than 4in in diameter.

he complete outfit, including plifier and playback speaker, kes up into a readily portable rying case.

typical machine would provide microphone or other input rce, would have a modulation el indicator, a footage indicator, plete playback facilities and a h-speed rewind. This latter al- s the wire to be run back on to storage spool in a fraction of normal forward playing time.

Wire recorders intended for studio rk have still more ambitious cifications, both electrical and chanical, and are capable of ex- lent fidelity.

Experience has dispelled the early rs that the recordings would eriorate with age or with re- ated playings. Tests have shown, the contrary, that they can be yed thousands of times with no ect other than a slight drop in erall level.

More serious in the case of wire, s been the problem of corrosion der humid conditions. Special oys have been developed, how- er, which are satisfactory in this pect while still showing good gnetic properties.

Like the original steel tape, wire a homogeneous material and the ect of the imposed recording is set up a continuously varying pat- n of magnetic flux along its length. ternatively, the action of a re- rded wave may be regarded as leaking up the medium into a large mber of tiny bar magnets, each ving its own north and south pole.

FECT OF SPEED

However, all these "bar magnets" e intimately coupled, being part the base material, and there is practical limit to the number of lem which can exist in a given gth of recording medium.

It follows, if a high frequency wave to be recorded, that the wire must ve at a certain minimum speed, erwise the rapid variations in x will not faithfully be recorded. nversely, if the wire moves past e recording head at some conveni- t and pre-determined speed, it will capable of recording faithfully ly up to a certain frequency, yond which the response will er rapidly.

The recording head has an important bearing on this frequency limit but, at this juncture, it is sufficient to note that the speed with which a given wire travels is closely related to the overall response.

Present day practice is to use a wire speed of about 30 inches per second for purely speech work, where mediocre top response can be tolerated. For wide-range recording, the wire speed is doubled.

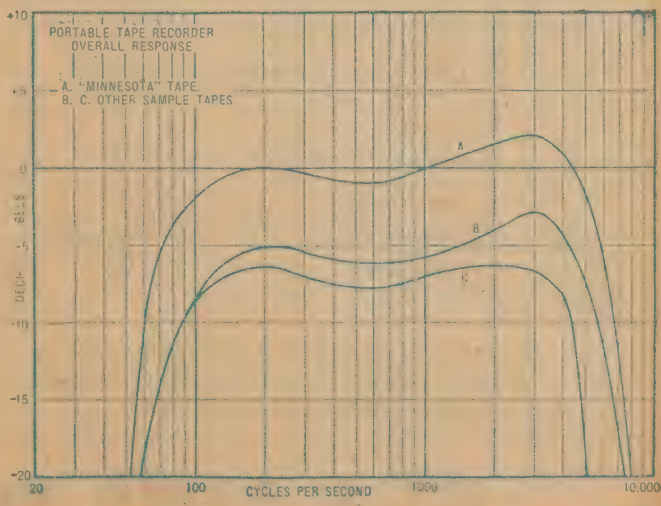
Research with a view to reducing the speed of the recording medium has led, along with other factors, to the development of modern recording tapes.

These tapes are quite different from the early steel varieties, in that they are made from cellulose acetate, paper or plastic—commonly PVC. One side is spray-coated with a thin layer (.0005 inch) of tiny magnetic particles suspended in a suitable binding material. The particles are quite independent of one another and each becomes a separate diminutive permanent magnet under the influence of the recording field.

It becomes possible as a result, to run tape at a comparatively slow speed for wide frequency response.

The earliest coated tapes were not very satisfactory, mainly because the particle size was much too large, to take proper advantage of the idea.

Enormous advances have since



Response and output from three tapes measured on another typical machine. Note the difference in level and the poor response of sample "C". The response of the machine as a whole indicates the need for additional compensation.

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IF174 Std. 455 K.C. low gain I.C.
IF162 Std. 460 K.C. square can 1st stage.
IF163 Std. 460 K.C. square can 2nd stage.
IF164 Std. 460 K.C. square can low gain.
IF168 Midget Magnasonic 1st stage I.C.
IF169 Midget Magnasonic 2nd stage I.C.
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E343 455 K.C. Air Core B'cast R.F.
E344 455 K.C. Air Core B'cast Osc.
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E346 460 K.C. I.C. B'cast R.F.
E347 460 K.C. I.C. B'cast Osc.
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H132 40 metre Air Core Osc.
H133 80 metre Air Core Aer.
H134 80 metre Air Core R.F.
H135 80 metre Air Core Osc.
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DW29 4/5 16.50 metres Dual Wave Unit.
DW37 5/6 Dual Wave Unit with R.F. stage.
K116 Std. Personal Coil Kit.
K117 4/5 Dual Wave Coil Kit complete with IF's.
K118 Midget Personal Coil Kit.
K120-5 Band Coil Kit.
K121 4/5 B'cast Coil Kit.
K122 5/6 B'cast Coil Kit.

Radio Frequency Chokes

RF81 Silk Honeycomb.
RF82 3 Pie 1.7 M/H.
RF83 4 Pie 2.5 M/H.
RF84 5 Pie 4.0 M/H.
RF85 6 Pie 7.0 M/H.
RF86 Cotton Honeycomb.
RF106 Low Tension Vibrator.

Speaker Transformers & Replacement Windings

TS23 Single Triode Low Imp. Trans.
TS24 Single Triode High Imp. Trans.
TS25 Push Pull Triode Low Imp. Trans.
TS26 Push Pull Triode High Imp. Trans.
TS27 Single Pentode Low Imp. Trans.
TS28 Single Pentode High Imp. Trans.
TS29 Push Pull Pentode Low Imp. Trans.
TS30 Push Pull Pentode High Imp. Trans.
F132 Single Triode Low Imp. Winding.
F133 Single Triode High Imp. Winding.
F134 Push Pull Triode Low Imp. Winding.
F135 Push Pull Triode High Imp. Winding.
F136 Single Pentode Low Imp. Winding.
F137 Single Pentode High Imp. Winding.
F138 Push Pull Pentode Low Imp. Winding.
F139 Push Pull Pentode High Imp. Winding.

Potentiometers

	Ohms	M/A
PT40	6	250
PT38	10	250
PT39	20	250
PT34	30	250
PT41	50	200
PT42	100	100
PT44	400	50
PT47	1000	35
PT48	1500	35
PT49	2500	30
PT51	5000	30
PT52	10000	25

Midget Variable Condensers

Star Type with face support.

Type	Plates	MMfd
CV34	2	10
CV35	3	15
CV36	4	25
CV37	5	35
CV38	7	50
CV39	9	70
CV40	14	100
M/C type with face and back support.		
CV41	2	10
CV42	3	15
CV43	4	25
CV44	5	35
CV45	7	50
CV46	9	70
CV47	14	100

Filter, Audio & Vibrator Chokes

TC60 100 M/A 30 H. Filter Chokes.
TC65 50 M/A 30 H. Filter Chokes.
TC66 New 14/60 Filter Choke.
TC80 150 M/A 20 H. Filter Choke.
TC81 200 M/A 20 H. Filter Choke.
TA4 100 H. 1000 ohm D.C. Res. Audi Choke.
TC58 Low Tension 3 Amp 50 M/H Vi Choke.
TC70 High Tension 75 M/A 50 H. Vi Choke.

Filament, Audio & Auto Trans.

TP1 2.5v 2 amps 7 watts Fil. Trans.
TP2 4v 1 amp 7 watts Fil. Trans.
TP3 6.3v 1/3 amp 7 watts Fil. Trans.
TP55 6.3v 3 amps 15 watts Fil Trans.
TP80 6.3v, 4v & 2.5v Auto Trans.
TB42 A Class Single Ratio 3 to 1 Audi Trans.
TB43 A Class Push Pull Ratio 3 to Audio Trans.
TB44 B Class Push Pull Ratio 1½ to Audio Trans.
TP81 135v-6v Vib. Trans.

Beat Frequency Oscillator Coils

F140 455 K.C.
F141 1600 K.C.
F142 1900 K.C.
F143 1/5 K.C.
F144 100 K.C.

Sundry Components

LF20 ¾ amp Line Filter.
LF24 2 amp Line Filter.
SW17 5 Band Switch.
KH34 Coil Lacquer.
1.24 1¼" dia. 6-Pin Coil Formers.
1.25 1½" dia. 6-Pin Coil Formers.
MO8 Dial Drive Drum Complete wit spring.
VD25 15000 ohm Voltage Divider.
VD28 25000 ohm Voltage Divider.
CG15 2-Plate Trimming Condenser.
CG16 2-Plate Trimming Condenser.
CG27 Five-in-One Trimmer 4.2 Plate 1.3 Plate.
DA7 Dual Wave Portable Dial.
MS7 x 25 12½" long, 2" wide, 25 Lug Res. Strip.
MS8 x 24 12½" long, ¾" wide, 25 Lugs.
AF12 Transposition Blocks (set of 8).
MO1 3/8 Magnetite FA304 I.C. per 10
SL3 Single Ended Solder Lugs, per 100
SL4 Pear Shaped Solder Lugs, per 100
SL5 Double Ended Solder Lugs, pe 1000.
1.27 1¼" dia. 6-Pin Coil Plugs.
1.28 1½" dia. 6-Pin Coil Plugs.
MO16 2¼ x 1¼ Clear Polystyrene Tubin
MO17 2½ x 1¼ Clear Polystyrene Tubin
P21 5-Plate Adjustable Padder.

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Illustrating the approved technique for splicing a tape. Cut the two ends simultaneously to give the same angle. Butt the ends carefully and join with ordinary adhesive tape. Finally trim the adhesive, undercutting it slightly to eliminate sticky edges. Properly effected, a tape joint like this is noiseless.

en made, however, in reducing and ntrolling particle size and constant provements are still being effected tape characteristics.

Even the class of tape released a w years ago—and still commonly ailable — has acquired the desiption "low coercivity." It is caple of extremely good fidelity, if n at 30 inches per second. However, e usual speed for such tape is 15 ches per second, for a top freency response of abut 10 Kc.

More recently, so-called "high ercivity" tapes have been developed hich feature reduced particle size id greater magnetic efficiency.

Kc PER INCH

Such tape, when used with suitly designed heads, will handle up approximately 8 Kc at a tape eed of only 7½ inches per second. achines have been released, which ilve this speed again, giving a reonse to 4 Kc for a tape speed of inches per second. This standard suitable only, at the moment, for eech work.

Tapes from various sources exhibit idely differing characteristics and is obvious that there is yet plenty room for development both in gard to tape itself and to recording id playback heads which will take est advantage of it.

In the meantime, the best studio pe equipment can make recordings hich can be regarded as "distortionss" for all practical purposes. It is mmon practice now for recording mpanies to record musical works itially on tape (although a few use ire). After editing and timing, they re re-recorded on disc, any adjustents to level &c., being made in the rocess.

MASTER TAPE

The master tape can then be stored ndefinitely for possible future reference.

Portable tape machines are very imilar in size and specifications to heir wire counterparts. The best of hem will record and play back peech and music with much the ame fidelity as from an ordinary ecord player with a frequency reponse up to 7 or 8 Kc. Background oise is somewhat lower, tolerance overload somewhat greater but hey are more prone to "flutter" ffects on sustained tones.

Notable troubles which occur in poorly designed machines (both tape and wire) include bad "flutter" or "wow," hum injection from the motor, poor fidelity and unreliable winding mechanism. Such troubles become increasingly significant as more ambitious recordings are attempted.

The impression gained from many of the smaller tape machines at present on the market is that they are still subject to development and continued manufacturing experience, even over the next few months, will iron out many "teething" troubles.

The machines incorporate equalisation to produce an acceptable balance on playback from their built-in speaker, thereby fulfilling their primary object. Reproduction through a larger amplifier system will generally obviate some of the "box" effect, which is natural to any small speaker and cabinet. However, it may also reveal the need for additional compensation to bass and treble to get the most pleasing reproduction under the improved conditions.

FURTHER WORK

In other words, a good deal of work remains to be done in relation to frequency standards, methods of compensation and so on, before the home recording enthusiast can realise the full potential of a simple tape recorder.

As the tape travels past the recording head, particles in the sensitised surface are magnetised in accordance with the speech currents which happen to be flowing as they pass the magnetic gap.

☆

The magnetic pattern retained by the tape energises the playback head and the signal is reproduced. The tape can be played thousands of times, the life being limited mainly by physical wear.

☆

Passing the tape beneath the erase head eliminates the signal and prepares the tape to receive the next recording. Given proper conditions, erasure is complete and no cross talk is experienced.

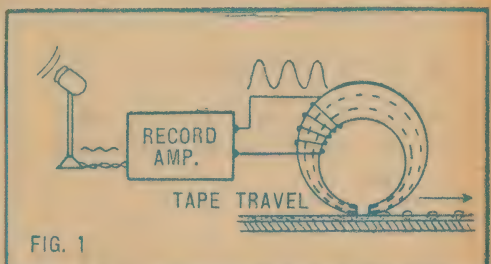

FIG. 1

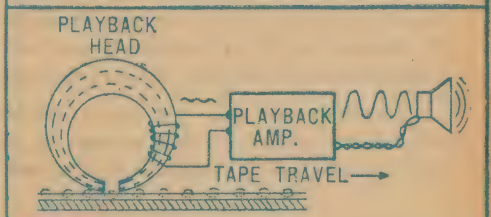

FIG. 2

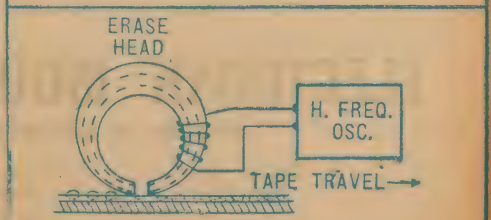

FIG. 3

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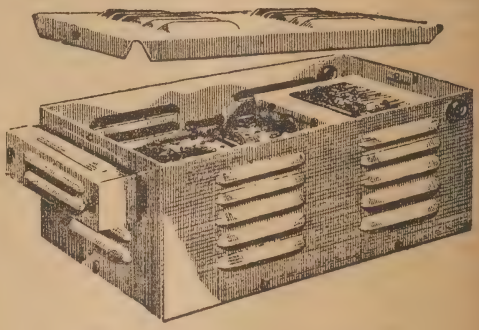

The Valradio invertor can be supplied with specially calibrated vibrators for any frequency within the range of 40 to 75 c/s. These invertors are suitable for most purposes where an AC supply is essential. The frequency stability is exceptionally good and may be used for driving tape recorders, synchronous gramophone motors and other devices requiring accurate frequency AC supply.

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In the meantime, and even without these complications, a tape recorder can be an enormous asset to teachers and students of voice production and music, to dramatic groups and so on, who may wish to hold immediate "post mortems" over their best efforts.

Tape is now made to the standard dimensions of ¼in wide and about .002in thick. It is loaded on standardised plastic spools which are very similar to those used for 8mm home movies.

The spools are made in 5in, 7in and 11in sizes, which give playing times, at 7½in per second, of 16, 32 and 86 minutes. The total length of tape and playing times for other speeds can readily be calculated from these figures.

COATED SIDE

Ordinary plastic tape has a shiny and a dull side, the latter being the spray coating. The tape must always be loaded so that this dull side is against the poles of the recording and playback heads.

Tape recordings were made initially with a single track down the centre of the tape. More recent practice, however, is to record two tracks side by side on the same tape, thereby doubling the playing time. With proper design, there is no leakage between tracks, the edges of the magnetic patterns being quite sharply defined.

The simplest two-track system involves offsetting the heads so that they are adjacent to a particular edge of the tape. Running the tape through in the normal way records a track down this side. At the end of the run, the reels are simply changed over, bringing the blank side of the tape adjacent to the heads.

The more complex arrangement is to have a small trip mechanism which automatically lowers the head at the end of the run and simultaneously reverses the direction of tape travel. The break is barely perceptible, with the result that a full hour's recording can be stored on a single 7in spool.

Apart from halving cost of tape, the two-track system has the advantage, for long works, that it runs the tape through in both directions, thereby obviating the need for rewinding.

In subsequent articles we plan to describe in greater detail typical winding mechanisms, head designs and so on.

WHICH IS BEST?

In the meantime, the favorite question posed by readers is, on the face of it, a very simple one . . "What is the best form of recording—wire, tape or disc?" The answer, in equally simple terms is "None." They all have special advantages and find their best application in different fields.

Considering wire, in the first instance, the chief advantage is in its small physical size which, despite a somewhat higher operating speed, allows lengthy recordings to be contained on quite small spools. Wire will probably continue to hold this physical advantage, although it must be remembered that any further reduction in wire size must be accompanied by increased difficulty in handling.

In all other respects it is probably true to say that tape is equal to and superior to wire.

It is capable of wider response for a given speed and the response is not subject to variation due to longitudinal rolling. Separation of the magnetic layers by the tape material prevents cross-talk developing in the reel, while complete erasure is more easily obtained.

Tape can be driven at constant speed by a central capstan, whereas similar provision with wire is difficult. Most wire machines exhibit a gradual increase in wire speed as the effective diameter of the take-up spool increases. This fact, together with the difficulty of joining fine wires, complicates any editing procedure.

In fact, the most obvious advantage of tape is its case of handling, since it is readily threaded and presents twice the breaking strain of wire.

In the event of a spooling accident, tape can be unwound all over the floor and still run back onto the spool without tangling. Once wire gets out of control, it can be written off.

For editing purposes, tape can be "spotted" easily, can be cut and spliced in a moment, or odd lengths can be joined together without audible effects. This is an enormous advantage for program production work.

PRACTICAL CASES

As an example, the writer recently watched the production of a quarter-hour radio session which, by reason of "fluffed" lines, sound effects and so on, involved re-starting or cutting the tape about a dozen times. The finished program, involving all these "bits" ran through without any apparent break.

In another case, a program editor in a Sydney station recently cut a great handful of "ers" and "ums" from an important speech, rather than play the recording in its original and rather tiresome form.

On another occasion, a badly "fluffed" name in a speech was corrected by re-recording the same word from another part of the speech, then cutting it into the tape in place of the mispronounced word.

For the home recordist, the attraction of tape is in the ease with which "casual" recordings can be made — the goings-on at a party, family efforts at entertainment, the description of a fight which father would otherwise miss. Such items can be recorded with extreme simplicity, played back a couple of times, then replaced on the same tape with something else of more immediate interest.

Items of special interest can, of course, be recorded and stored for future use and a seven-inch reel on a twin-track machine offers a full hour of recording time. Once the level is set, it is generally possible

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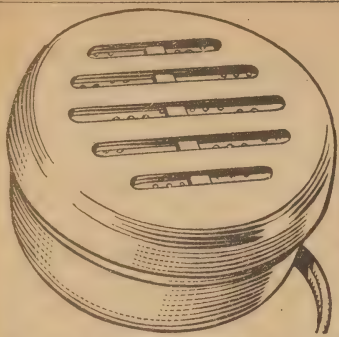

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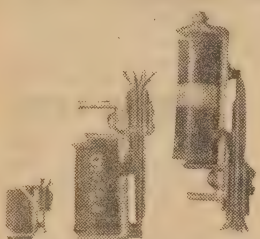

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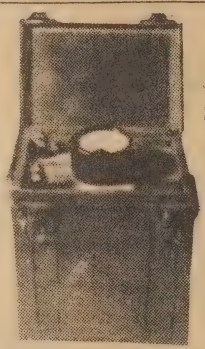

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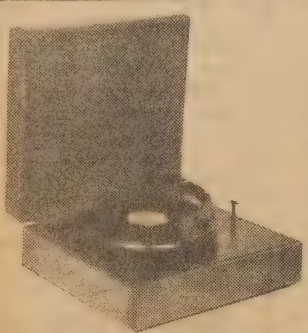

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leave the machine, since there little chance of anything going iss.

It is not normally necessary speci- y to erase a program from a tape fore the next one is recorded. The rangement of the recording and ase heads in most machines is such at the new program can be run aight over the top of an old one, e unwanted signal being erased in e process.

All these features brand tape re- rding as an ideal medium for what have called "casual" recording in e home, the studio, the office and on. Apart from the initial out- for a couple of reels of tape, any nount of recording can be done er that, at virtually no cost.

Where it may be desired to keep recording for future playing, or ere it is desired to build up a me-recorded library, the picture anges somewhat in favor of disc. is is especially true in the face current developments in home icrogroove recording.

OST OF TAPE

On the matter of cost, a reel of od tape, covering one hour's re- rding time, is considerably more pensive even than two 12-inch ace- te discs. While the discs will cer- inly not be capable of re-play as any times, their life may be ade- ate, which is really the important nsideration.

Tape also lacks the versatility of sc for playing back in that it is t possible simply to lift the pickup ad and, by a quick process, select y passage from a major work. Nor it possible to play immediately single item from a half-hour pro- am on tape.

Selection of a particular item in e middle of a tape involves initi- ly loading the machine, then man- ulating the high-speed controls un- l, by a process of trial and error, e required number is located.

On a purely commercial basis, it hard to visualise tape ever replac- g the popular "five bob platter" hich is picked up at the corner ore, dumped on the turntable and layed over with a minimum of fort.

IO REAL COMPARISON

In this field at least — and it is very large field — the properties tape and disc are so divergent that is futile to even attempt compari- on.

In the process of time, tape may ave an important impact on the ng-playing "classical" market, but is can only be a matter for con- ecture at present. It yet remains be seen how cheaply tape playing ecks can be made, how cheaply ape can be made and how good by omparison will be the mass-pro- uced tapes and microgrooves.

The fact remains, however, that ape recording has arrived in no un- ertain fashion and, even if it exists nly to fill a completely new and dif- erent field, enthusiasts will want to now all about it.

In subsequent articles we plan to ell you the story of tape.

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HERE'S A DIFFERENCE--POWER OUTPUT AND GAIN

o a beginner, the most obvious characteristic of a new set is its loudness n local stations. They may discover, however, that a "loud" set will ot necessarily pick up distant stations—perhaps not as well as another much "softer" set. Why the apparent contradiction?

ctually, there is no contradiction ll—it's just the difference between wer output" and "gain." Let's ex- n the terms.

Power output" depends mainly on valve which feeds the loud- ker. It is measured in electrical s and, logically, a valve which deliver several watts of audio er output can make a lot more e through a speaker than one h delivers only a fraction of a .

ow the power from a particular ut stage depends chiefly on the of output valve (or valves) and he conditions of operation.

or example, the average house- AC receiver uses a 6V6 or 6F6 rive the loudspeaker. It operates about 250 volts on the plate and en and draws a current of about nilliamps. Pushed to its limit, the ut stage can deliver between 3 4 watts of audio power. Try to e it deliver more power than by turning up the volume con- , and the sound becomes dis- ed.

GHER POWER

you happen to live in an extra- narily large home and want ier volume than a single 6V6 can , it becomes necessary to use two es in push-pull or to select a le large valve to deliver the ired number of audio watts.

's rather like the speed of a or car. The average commercial will cruise quite happily at 50 mph and that's just about as as most people want to go most he time. If, however, you demand travel consistently at 90 mph, it omes necessary to choose a more borate vehicle, which is intrinsic- capable of meeting your require- nts.

lowever, big amplifiers, like big tor cars, are inherently more ex- sive to buy and maintain and nomies are often necessary for ctical reasons. Thus, in a battery one is obliged to use quite a small put valve which might be capable a maximum undistorted power nd about the quarter-watt mark. matter how you manipulate the trols of the little battery set, it er can sound as loud as its AC nterpart.

hat's half the story.

IVE REQUIREMENTS

he next point is simply that any put valve needs a certain amount signal on its grid to drive it to full wer output. The 6V6, for example, eds about 12 volts peak and, when plied with this, it will deliver its dd watts of audio power. But how get the 12 volts peak signal?

f you happen to live very close a station, you might get fully half olt across the first coil, so that just a high gain detector might deliver all the signal necessary to swing the output valve to full power. Your 2-valve-plus-rectifier set would sound as loud as a commercial superhet. It would have plenty of power output!

But what of the gain? In actual fact it would be very low and the set may not even receive a more distant station, let alone play it at the volume of which the output valve is capable.

Another set with a high-gain tuning system may be able to tune the distant station easily and amplify the signal enough to drive the output valve to full gain. If the output valve happens to be a small one, the actual maximum audio POWER on any station may not be as great but the extra GAIN allows it to produce this power from all signals.

The same applies to audio amplifiers. A simple two-stage affair may provide plenty of POWER-OUTPUT when used with a pickup capable of providing enough signal to drive it. Used with a low level pickup or a microphone, the same amplifier would not sound very loud because it would lack the GAIN to amplify the weaker signal.

A handy rule of thumb can serve as a guide. If you find that a receiver or amplifier is not loud enough with all controls set for the loudest signals, the indications are that it has insufficient GAIN.

If the controls cannot be turned full on because of distortion, and the volume is still not adequate, indications are that more POWER is required.

Pushing the analogy of the motor car a step further, you could, with some stretch of the imagination, liken a high gain low power amplifier to a light sports car while a low gain high output amplifier could be likened to a heavy duty truck. The former has plenty of zipp but not much punch while the latter has plenty of punch but not much zipp.

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M3

Here's your answer, Tom!

The way Tom jumps about from one subject to another he must be playing game of mental leapfrog. Let's hope, at any rate, that some of the answers will prevent him from hopping into hot water.

THE first question, or rather the answer to it, strikes a topical note with all the current shortages of "essential" commodities.

What is a dry joint and if a dry joint is a bad thing, how do you go about making it wet again?

We decided to put your query to our artist, Tom, and his answer is published herewith. As for improving the situation, unless you hold shares in the brewery there is little you can do about it.

Possibly our artist has more than a sneaking regard for Bacchus, the god of Greek mythology. His impressions are likely to be somewhat

biased and it is only fair that we point out that, so far as the radio fraternity is concerned, a dry joint would refer to a poorly soldered connection.

A dry joint could be caused by a thin layer of dirt or enamel surrounding the wire being soldered. Although the joint may appear quite OK mechanically it is actually possible for the wire to be insulated from the blob of solder, instead of being bonded to it.

A completely "dry" joint is usually not too difficult to find but the really nasty problem arises when there is only a partial connection. You meet the kind of situation where the set will work perfectly, if stood on its end, but refuses to utter more than a garbled crackle if placed in the position its creators intended.

Then again, you get the temperamental set which goes on strike when the weather is too hot or the atmosphere too humid. Possibly our artist had this sort of climate in mind.

The remedy is to clean thoroughly all parts before soldering, either with a knife or emery cloth, and use a smear of flux only. When the soldering iron is applied, leave it on long enough to heat both parts of the joint to the melting point of the solder but not long enough to scorch the rubber insulation or melt the plastic covering on the wire, as the case may be.

It takes a little time to develop the skill necessary to make good solder joints quickly but it isn't as difficult as many people would make out. The main thing is to recognise that some skill is required.

What is the difference between the action of a filter condenser and a bypass condenser and do filter condensers ever appear anywhere besides each side of the filter choke?

We hadn't thought of that one to date, Tom, but the difference is more in our conception of the action than the action itself. In both cases, the condenser's ability is used to store energy and then deliver it back again into the circuit.

Take the case of the first filter condenser which, in most receivers, is connected between the filament of the rectifier and ground. Power is delivered to it from the rectifier in a series of pulses and the condenser charges to near the peak value of the applied voltage.

After the peak passes, the voltage delivered by the rectifier falls below the level of the charge in the condenser and the condenser passes current back into the filter circuit. You can see, therefore, that the condenser tends to keep the level of the voltage constant. Its ability to do this—or the amount of filtering it is able to do—depends largely on its capacitance.

A small condenser could charge up to the peak value just the same as a large condenser but it would only be able to store a small amount of power. In consequence, it would allow the voltage to drop immediately when the peak is passed. For this reason you will find that most filter condensers have a fairly large value of capacitance. Common values for receivers are 8 mfd and 16 mfd.

The action of a bypass condenser is really much the same. Take, f example, the bypass condens across the cathode resistor of amplifying valve.

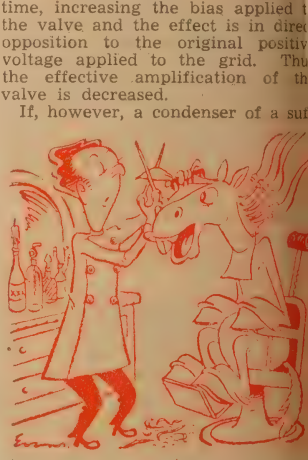
Without the condenser in pla the current through the resistor the instantaneous current throu the valve and it follows, from Ohm law, that the voltage across the r sistor is proportional to the insta taneous current.

Get a piece of paper, Tom, ar draw out the circuit of a triode an plifying valve, including the gri plate, cathode and the cathode bi resistor.

Now, say for instance, that a pos tive-going voltage pulse is applied the grid. From your understandin of valves you know that the curre through the valve will increas Since the resistor is in series wit the valve current through the re sistor will also increase and, as ex plained before, the voltage across t resistor will increase in proportio

But this voltage is, at the sam time, increasing the bias applied t the valve and the effect is in direc opposition to the original positiv voltage applied to the grid. Thu the effective amplification of th valve is decreased.

If, however, a condenser of a suf



ficiently large capacitance is con nected across the cathode bias re sistor, it tends to hold the voltag constant, regardless of quick change of current through the valve. Thi condenser is generally known as bypass condenser although it could with some justification, be called filter condenser.

The screen bypass condenser fo a pentode valve has much the sam action except that, due to the dif ferent characteristics of the circui a comparatively small valve capacitance can be used to get th same effect.

ter condensers appear quite in places other than alongside ilter choke. High gain audio s are frequently operated from oupling network consisting of a or and condenser. The con- r could well be referred to as er condenser.

ese "filter" condensers appear e strangest places. For in- e, the condenser connected s a detector diode load resistor filter condenser despite the fact its capacitance is only about mmfd. Quite a low value is actory since the frequencies in- d are high.

the case of the crystal set ifier recently described, the n of the valve is connected to tension. Would the screen not t all the signal and leave none he plate? Would the volume eater if I connected the screen e plate side of the phones so both elements collect the sig-

Tom, it's a case of each man own job or this time each ele- to its own job. Imagine a hairdresser giving a horse a trim!

e screen is put in the valve to certain job which it cannot do tively unless it is connected as ded. We cannot start a dis- on on valve theory just at the ent but suggest that you check the chapters on valve theory in of the standard text books such e A.R.R.L. Handbook.

intend publishing some articles lves following directly after the rn While You Build" series. articles will take the form of ical experiments which you can out at home.

the "Senior Portable" circuit is the meaning of the dotted between the B-minus and the -jus terminals?

ell, Tom, we can appreciate your culty because dotted lines are for all sorts of things these . For instance, you sign your on them, you are asked to around them and, in Sydney, have lines dotted with people have been shaken off the trams. again, someone has suggested dotted "lions" might be mis- for leopards.

this case, however, the dotted simply means that the two sec- of the switch are ganged to- r so that they operate simul- ously.

metimes the same symbol is to indicate that two or more ons of a tuning gang operate her although this is obvious in circuits and is therefore fre- tly omitted.

have sometimes seen the name nsceiver." Is it a cross between ansmitter and a receiver?

es, Tom, you have just about med the situation up. And a ly horrible device often results,

e usual type of transceiver con- of an RF valve and an audio ifier. By means of the switching and interconnecting wiring the RF valve is connected as a detector in the "Receive" position and the audio amplifier amplifies the output of the detector to operate a loudspeaker or a pair of phones.

For transmitting, the detector is made to work as an RF oscillator by suitably changing the circuit constants. The output of a microphone is fed into the audio amplifier which is switched to modulate the DC current feeding the RF valves.

All this sounds very neat on paper but in practice it is, at best, a poor compromise. The detector, which must be a super-regenerator without an RF stage, radiates almost as much power on "Receive" as on "Transmit." The receiver and transmitter always operate on slightly different frequencies so that two transceivers working together have to keep returning to each other, and the audio amplifier which is suitable for the receiver is not necessarily suitable for the transmitter.

Transceivers are not to be recommended except for portable and emergency equipment and then only when it is operating on the ultra-high frequency bands.

What is the difference between a directly and an indirectly heated rectifier? As far as I can see they both operate in exactly the same way.

In many applications, either a directly or an indirectly heated rectifier could be used. However, Tom, there are certain jobs where an indirectly heated rectifier is an advantage.

The most obvious application is to a vibrator receiver where it is desired to operate all the valve filaments from the one battery. In this case the insulation around the heater element is sufficient to withstand the high tension voltage. Similarly, such a valve can be used where there is only one filament winding available. The 6X5-GT is perhaps the best known valve of this type.

A directly heated rectifier such as type 5Y3-GT heats to full operating temperature much more quickly than the other indirectly heated valves in the set. In consequence, there is a short period when the rectifier is delivering full power and no power is being taken by the valves, with the result that the voltage rises to a value well above normal.

The indirectly heated rectifier takes about the same time to reach operating temperature as the other valves and therefore the voltage never rises above the normal figure. Note that a number of indirectly heated rectifiers are not designed to withstand a high voltage between heater and cathode and should be operated from a separate filament winding one end of which is often connected to the cathode.

Directly heated rectifiers are cheap to make and because there are few parts there is less chance of troubles developing. The reliability of the old 80 and 5Y3-GT types has made them most popular for domestic receiver applications.

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These streamlined amplifier foundation units consist of a standard chassis 3" deep with removable top in aluminium. Fitting over the top is a removable cover which has louvres on all sides and handles welded to the ends. Color Grey.

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AC3	17	7	9	£2 3 0
AC4	17	10	9	£3 0 0

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AC SF 1779	17	7	9½	£2 11 0
AC SF 17109	17	10	9½	£3 5 6

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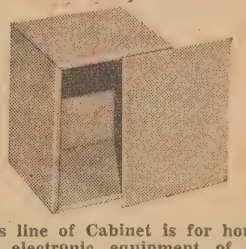

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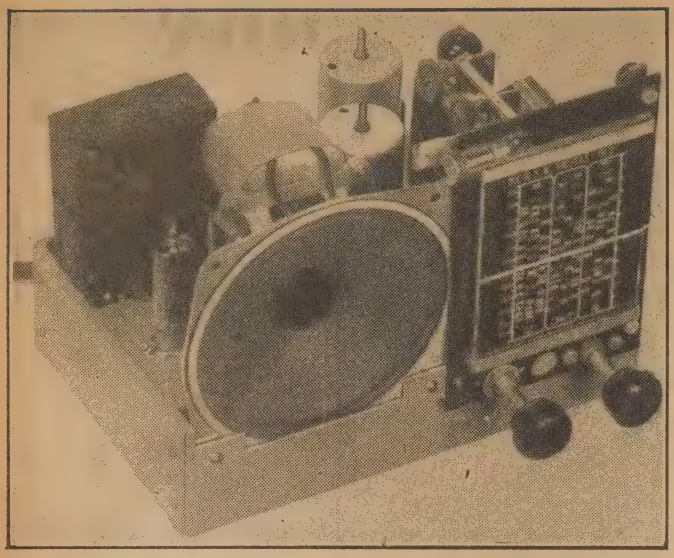


The neat and compact arrangement of the set can be seen in this view. The volume control is on the left, tuning on the right. Place a small washer between the speaker and the chassis on each of the front securing bolts.

LITTLE GENERAL FOR 195

RADIO AND HOBBIES KIT No. 8

Here is a new and up-to-the-minute version of our famous "Little General"—the most successful design ever presented for home construction. Designed around new components and valves, the new set will out-perform any of its predecessors. The traditional layout has been retained but mounting arrangements have been completely rationalised for your convenience.

by Raymond Howe

SINCE the introduction of the Little General in 1941, literally tens of thousands have been turned out in the home builders' workshops, for it is one of those sets which have maintained its interest over the years. The reason for this is simple. The design is straightforward, it is cheap to build, it has no unnecessary frills and yet will give a performance which is on a par with commercial mantel receivers.

BASIC SIMPLICITY

We have suggested circuit amendments and even described a dual-wave version but the emphasis has always been on simplicity.

The last description of the Little General was in August, 1947, issue of Radio and Hobbies. Since then, the appearance on the market of a smaller power transformer, tuning gang and miniature valves has paved the way for a new Little General, one which is in step with these modern components. Naturally, a new chassis design is required but this has its good points in view of the few discrepancies which have crept in with the variation of components over the years.

Broadly speaking, the set has been redesigned to take in modern components while retaining the same overall size of chassis as before so that it will fit into the standard Little General cabinet. The only modification to the old cabinet will be in the size of the dial cut-out. We have made these particulars available to the chassis manufacturers so that future cabinets will fit the new design.

Similarly, the new chassis design has been passed on to the chassis manufacturers so that supplies to t usual radio distributors can be a ranged.

The new edge-lit dial used is t latest design in this type by the Ef Company. It has straight-line tuni with vertical travel. Although dearer type than the old Little Ge eral dial, it is better, both in acti and appearance. Besides, it allo for easier alignment when both d glass and pointer are together on t chassis.

REDUCED SIZE

Actually, this dial takes the pla of the older version of the same ty number. It is smaller in both dime sions, carries a different drive spin for the cord and has a separate tra bar for the pointer. The dial gla and escutcheon is the same. Ma sure when you are purchasing t dial that you get this latest desig using a back-plate measuring inches wide.

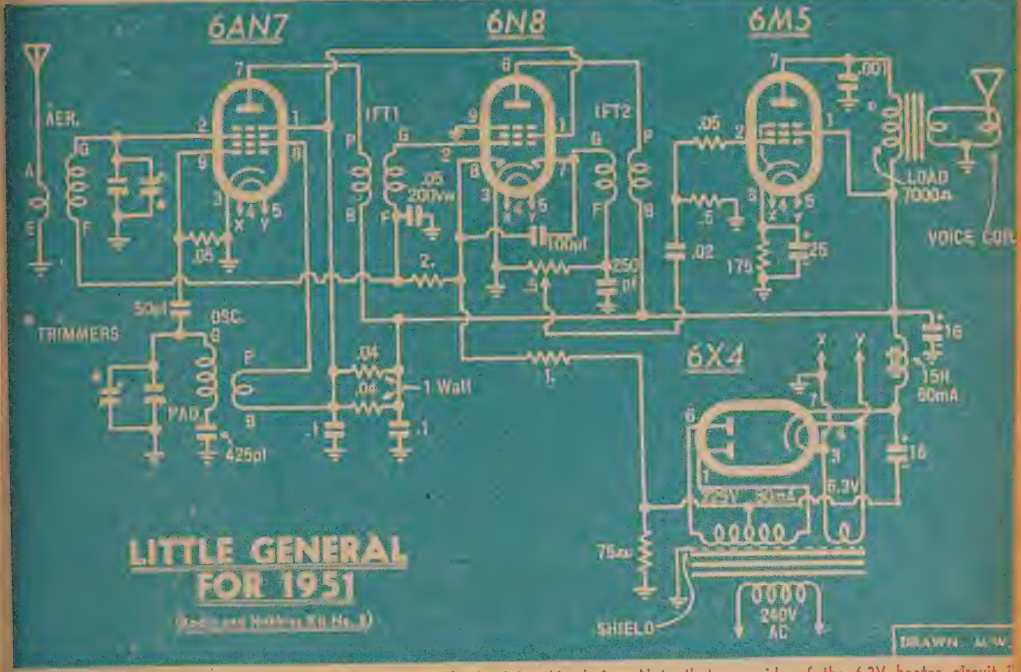
The valves used are types whi are normally as plentiful as oth types, bearing in mind the gener supply position at present. At a pin you can enlarge the socket holes a use larger valves, for we have deli erately left room for them.

CONVERTER STAGE

The 6AN7 triode-hexode convert was selected for the first stage b cause of its high conversion tran conductance and the fact that it c be used with a standard oscillat coil and circuit. The X61M a ECH35 have somewhat similar cha acteristics but, of course, are in t larger octal-based series.

The 6N8 is the logical choice f the IF amplifier and diode detecto AVC stage, it being the only du diode-pentode valve available in t miniature series. In the octal-bas types, the 6AR7-GT is a near-equiv lent with a slightly higher mutu

CIRCUIT DIAGRAM FOR 1951 LITTLE GENERAL



Basic simplicity of the early Little General circuit is maintained in this design. Note that one side of the 6.3V heater circuit is connected to chassis, preferably at each of the valve sockets other than the rectifier.

conductance rating for the pentode section.

In the output stage, a power pentode which requires very little drive for a moderate power output is to be desired, in view of the absence of audio voltage amplification following detection.

The 6M5 fits nicely into the picture here. Its high mutual conductance permits an output of over 3 watts for about 3 volts of grid drive and with a high tension supply of about 235 volts.

GRID "STOPPER"

The only penalty to be paid for the use of high GM in this stage is the fitting of a resistor in series with the grid lead to prevent parasitic oscillation—a small price, indeed.

The miniature 6AQ5 and the octal-based 6V6-GT have similar electrical characteristics and although they have slightly greater power output capabilities, the drive requirements are not as low as for the 6M5. Anyway, the full output of the 6M5 is not required in a mantel set, particularly in view of the fact that only a 5-inch speaker is used. The low drive requirement for a given output is more important.

The KT61 and the EL3NG are similar to the 6M5 in this respect but the larger physical size has to be considered. The use of the miniature tuning gang allows sufficient room on the chassis for either of these valves but their height is such that there is barely room for the set to slip into the standard cabinet without the valve envelope fouling the cabinet top. If you do use these valves, watch this point.

Reviewing the circuit as a whole and comparing it with the previous circuit of the Little General, you will see that only minor changes have been made. The main point of difference is that the control of volume has been shifted from the cathode cir of the converter and IF valves to detector diode circuit.

The reason for this is two-fold permits normal application of a matic volume control (AVC), a g thing anyway and, by reason of turning the AVC line to the b bias resistor, the cathodes of the converter and IF valves ca earthed directly, making for ea wiring. Usually any attempt to

PARTS LIST

- 1 Chassis 8½" x 5½" x 2¼".
- 1 Little General cabinet (modified).
- 1 Power transformer 225V a side at 50 mA, 6.3V at 2A. (PF201 or similar).
- 1 60 mA filter choke.
- 1 Miniature 2-section gang tuning capacitor (AWA or similar).
- 1 Dial to suit (EFCO SLV21).
- 1 Broadcast aerial coil, 1 broadcast oscillator coil.
- 2 Standard 455 kc IF transformers, No. 1 and 2.
- 2 Gang trimming capacitors.
- 1 5-inch speaker with 7000 ohm transformer.
- 3 9-pin "innoval" sockets, 1 miniature 7-pin socket.

VALVES

1 6AN7, 1 6N8, 1 6M5, 1 6X4.

CAPACITORS

1 25 mfd 40PV midget electrolytic, 2 1 mfd 525PV electrolytics, 2 .1 mfd 40 VW, 1 .05 mfd 200VW, 1 .02 mfd, .001 mfd, 1 425 pf mica (lo tolerance), 1 250 pf mica, 1 100 mica, 1 50 pf mica.

RESISTORS

1 2 meg. ½ watt, 1 1 meg. ½ watt, 1 meg. potentiometer, 1 .5 meg. ½ wa 2 .05 meg. ½ watt, 2 .04 meg. 1 wa 1 175 ohm ½ or 1 watt, 1 75 ohm ½ 1 watt.

SUNDRIES

2 Knobs, 1 dial lamp 6V .15A or .3 1 4-tag mounting strip, 1 1" thread mounting pillar, scrap aluminium f coil bracket, 3-core power flex a plug, 2 terminals (1 red, 1 black), 5/16" and 2 ¼" rubber gromme hook-up wire, spaghetti, solder, sold lugs, nuts, bolts, etc.

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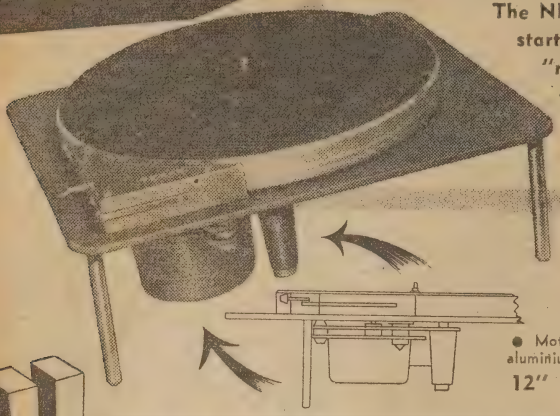

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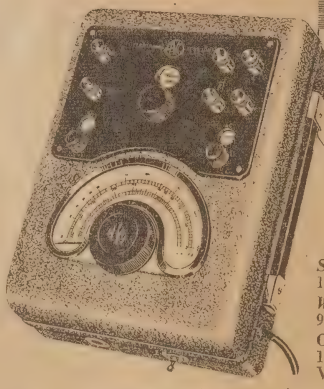

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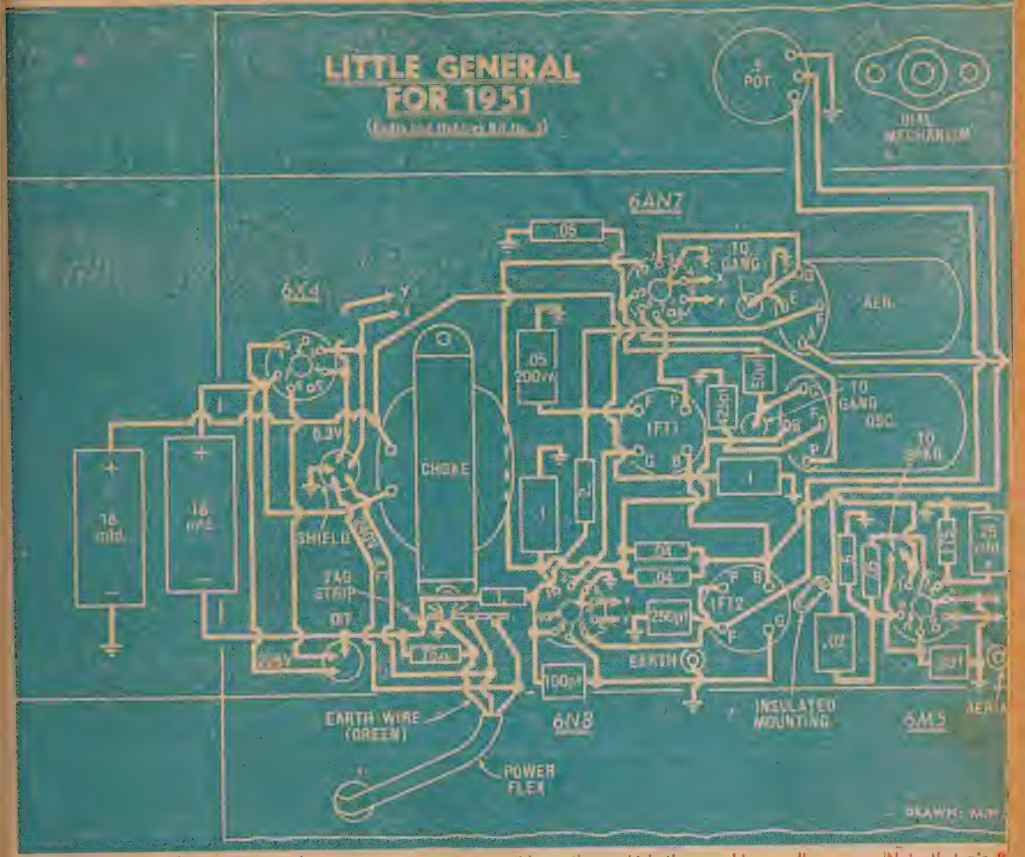
WIRING DIAGRAM OF 1951 LITTLE GENERAL



This diagram shows the components in positions as near as possible to those which they would normally occupy. Note that pin 9 on the 6M5 socket is used as an anchor point for the junction of the .05 grid stopper and the .02 coupling capacitor to the 6M5. Do not use any other "blank" pins on this socket as anchor points.

vide common cathode biasing for two high-gain stages necessitates a large value of cathode bypass capacitor to maintain stability.

As in the old circuit, the screens of the converter and IF valves and the oscillator B-plus is supplied through a common dropping resistor from the high tension line. The appropriate value and desired wattage is obtained by connecting two .04 megohm 1 watt resistors in parallel. This gives a resultant resistance value of .02 megohm and a dissipation figure of 2 watts. This value of dropping resistor provides a "no signal" voltage of about 85 volts to the screens and oscillator B-plus.

AVC LINE

The "lower" end of the grid winding of the IFT1 is paralleled with the "lower" end of the aerial coil grid winding. It is bypassed and connected to the 1 megohm AVC load resistor via a 2 megohm isolating resistor. This common decoupling works out quite nicely.

The 1 megohm AVC load resistor is returned to chassis via the 75 ohm back-bias resistor, thus effectively placing a few volts of negative bias on the AVC line to provide a standing bias for the converter and IF valves and delay for the AVC.

SENSITIVITY

The "no-signal" sensitivity of the set can be controlled by the value of this back-bias resistor. Actually, we arranged the back-bias to be about 1 volt greater than the nominal minus 2 volts required by these valves under their typical operating conditions just to keep them well under control. Reducing the value might improve the general sensitivity, but variations in the arrangement of the wiring might then lead to instability in some cases.

As mentioned, the volume control potentiometer acts as the load resistor in the detector diode circuit. The audio signal voltages developed across this load are picked off between the moving arm and the "earth" end and fed to the grid of the 6M5 output valve.

This gives a smoother control ov the volume as compared with var ing the bias on the first two stag and is the usual manner employ in most sets.

No RF filtering was required b tween the "F" terminal of IFT2 a the .5 megohm volume control, t single 250 pf capacitor at this po proving sufficient.

OUTPUT STAGE

The 6M5 output stage is qu straightforward and warrants lit comment in the light of previo remarks on this stage. Cathode bia ing is to be preferred in this instan The .001 mfd capacitor from t plate to earth is there as a preca tion against instability by keepi the leads to the speaker transform "cold" to RF. You may not find necessary, as its use is somewh dependent upon the arrangement the wiring. One side of the speak voice coil is shown earthed for t same reason and the same rema apply.

The power supply follows the us

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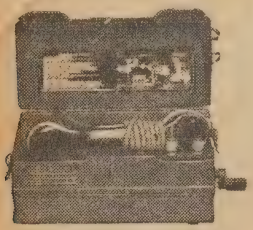

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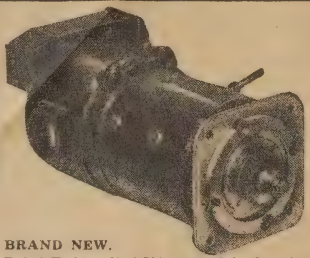

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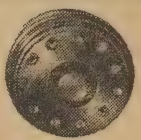

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Moulded 11-pin sockets with silver plated contacts. As illustrated, 9/6.

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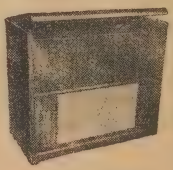

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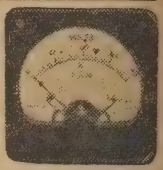

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"Radio and Hobbies" Car Radio Kit as described in May, 1949, issue of "Radio & Hobbies." Homecrafts offer this kit complete to the last nut and bolt. Price, as illustrated, 22 Gns, including Sales Tax.

290 LONSDALE STREET, MELBOURNE - - CENT. 4311

trend with 16 mfd electrolytics used in conjunction with a standard filter choke to keep the hum level low. The filter choke used in this set has a nominal DC resistance of 300 ohms. Chokes having higher DC resistance will reduce the output voltage from the filter in proportion. However, the difference will not be very much, being no more than 10 to 15 volts.

If larger values of filter capacitors were in ready supply, it may have been possible to have dispensed with the choke in favor of a resistance-capacitance filter network, as in some commercial receivers. However, we ultimately decided against this.

The 6X4 rectifier is used because it is the only miniature type available. The octal-based 6X5-GT has similar electrical characteristics.

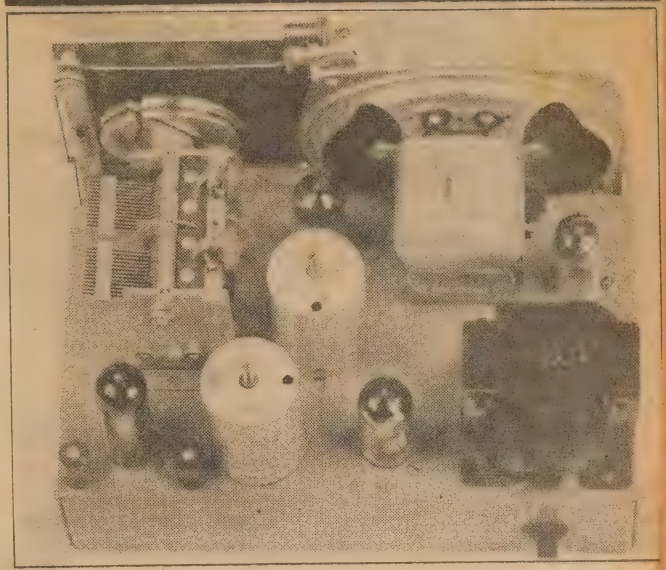
TRANSFORMER RATING

The rating of the power transformer is just about right for the purpose. With the 6X4 (or the 6X5-GT), the overall impedance of the power supply including the filter network is such that the output voltage is about 235 volts at the total current drain of about 47 mA.

As far as this and similar power transformers are concerned, the 5-volt type of rectifier is "out" because the only heater winding is at 6.3 volts. Of course, the 6.3 could be dropped to 5 volts but this is a messy arrangement under the circumstances.

The new chassis design will supersede all previous designs. This brings up an important point. As it stands, the chassis will be punched for the standard miniature 7-pin socket and the 9-pin "innoval" miniature socket. The one size of socket hole will cope with both of these types. For those constructors who may want to use the standard octal-based valves, it will be necessary to order the chassis accordingly, stating that the 1 1-8-inch socket holes are required. The chassis blueprint is marked for the two sizes of holes.

REAR VIEW OF RECEIVER



This rear view shows the location of the major components on the top of the chassis. The 6X4 is at the top right. The 6AN7 is at the centre top, the 6N8 to the right of the centre rear and the 6M5 at the extreme left rear. Note the two trimmers mounted on top of the tuning gang.

If you want to make up your own chassis, the blueprint is available from this office. The procedure is outlined in the panel on the "Answers to Correspondents" page of every issue of Radio and Hobbies.

On the constructional side, many of the general hints have been covered in previous articles on sets, particularly those in the Kit series. However, there are a few which are peculiar to this set and which w be covered in the brief discussion follow.

The location of the major cor ponents, both on top and underneat the chassis, can be clearly seen in t photographs of the set. In the re top view, the 6X4 rectifier is in t top right corner. The 6AN7 is in t centre top followed to the rear the IFT1, to the 6N8 slightly to t right and thence to the IFT2 and t 6M5 to the left along the rear ed of the chassis.

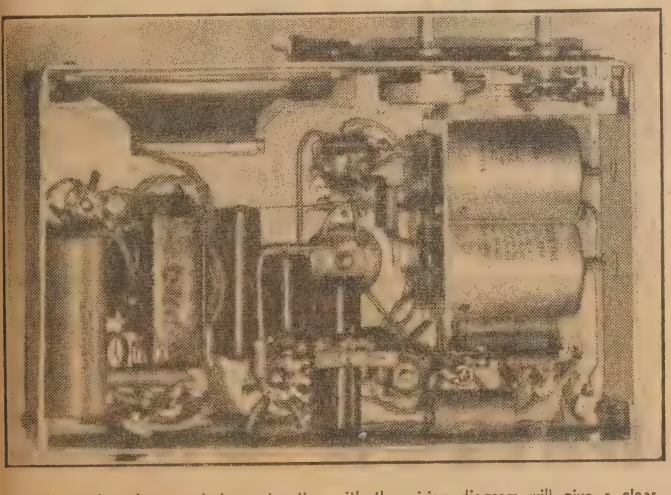
The aerial terminal is at the e treme left corner near the 6M5 the rear view. Note that the aer and oscillator gang section trimm are mounted on top of the ga When fitting them into place, ea that lug of the trimmer which is p of the top plate. This allows a me screwdriver to be used during alig ment without upsetting the circuit

DIAL MODIFICATION

Before mounting the dial, snip retaining wire clip which pins dial glass bottom clamp to the c back plate, leaving 1-8 to ¼ i protruding through each lug of clamp. This will allow the dial pl to fit flush against the chassis.

The dial drive drum should "floated" on the gang spindle freed from the dial back-plate. W ready to fit the dial, remove screw holding the drum to the plate and, as you are fitting the into place, slip the drum onto gang spindle.

When the dial is securely in pla tighten the dial drum grub screw to the gang spindle so that there



Studying this photograph in conjunction with the wiring diagram will give a clear idea where the components will fall. The 16 mfd electrolytics are placed one on top of the other between the choke and the chassis end. The .001 mfd capacitor from the plate of the 6M5 to earth is not shown.

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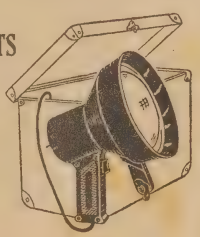

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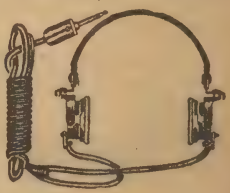

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qual overlap of the dial pointer at ach end of the dial.

The dial mounting is fairly rigid ut if you want to take it a step rther, fit a small brace plate from ne corner of the speaker frame to ie bolt holding the dial lamp racket.

The speaker is secured both to the ıside front face and the upper face f the chassis in the case of the type hich has the large retaining bracket or the pole pieces forming part of ie frame structure. For other types, ecuring to the inside front face f the chassis should be sufficient. not, it would be an easy matter to rap a metal strap around the mag-et and bolt it to the chassis.

From the underneath view, you ill see that the aerial and oscillator oils are mounted on a bracket be-w the tuning gang. First slip the olume control into place, then fit the oil mounting bracket with the ıounting foot toward the nearest ide of the chassis. The coils can ien slip into place by feeding the lug adjustment screws through the oles in the side of the chassis and acking them into place on the racket. The aerial coil is the one ear the dial.

COIL BOLT

Before fitting the oscillator coil, ut the securing bolt which will be ear the chassis, down to a length vhich will just nicely take a nut vhen protruding through the racket. This allows the 425 pf pad-er and the 50 pf oscillator grid capa-itors to fit nicely into place.

The filter choke is secured at one nd under the bolt holding the peaker pole bracket to the top of he chassis. The bolt holding the ther end of the choke must be fitted nto place before the power trans-ormer is secured to the chassis, as it alls right underneath that spot. In-identally, this hole should be coun-ersunk and a countersunk-head bolt ıised.

A 4-tag mounting strip is held ınder this securing bolt of the filter hoke. This tag carries the earth eturns of the two 16 mfd electro-ytics, the 75 ohm back-bias resistor ınd the incoming mains lead. The emaining insulating stand-off is a nounting pillar threaded at both ends and screwed on to the IFT2 ecuring bolt near the 6M5 socket.

The orientation of the valve ockets, coils and IF transformers can be deduced from the under-hassis wiring diagram. This layout is purposely selected for easy wir-ng and stable performance.

EARTHING LUGS

Earth lugs were placed under both nolding bolts of the 6AN7 and 6N8 sockets, under one of the 6M5 socket nearest the coils, under one of the IFT1 near the 6AN7 socket and under one of the IFT2 near the 6M5 socket. Connect all earth lugs to-gether with a run of light gauge tinned copper wire to avoid the pos-sibility of "bad" earths.

Don't forget to earth the centre spigot of the miniature sockets as this acts as a form of shield between the valve pin connections. This doesn't apply to the rectifier socket, of course.

Any further information on the wiring and placing of minor com-ponents can be gleaned from both the underchassis photograph and wiring diagram. Incidentally, be-cause the 6M5 is the only audio valve, it is possible to dispense with shield-ing of the leads to and from the volume control provided that they are kept close to the chassis and run along the fold in the coil bracket on the same side of the bracket as the coils.

IMPORTANT POINT

One important point which may not be emphasised in the photograph or wiring diagram is that the 2 meg-ohm and the 1 megohm resistors con-necting to the pin No. 8 (the diode used for AVC) on the 6N8 socket should be mounted fairly close to this pin, trimming the pigtail of the resistors to allow for this. The point is that this end of these resistors is "hot" to RF and it is inadvisable to extend the connection unnecessarily. The extension of the pigtail on the other end of these resistors is not important.

The connection of a 6-volt .3 am-pere dial lamp to the 6.3-volt wind-ing on the power transformer will bring the total load to just over 2 amperes. Although the winding is rated at 2 amperes, the rating is nominal and the transformer manu-facturer is not perturbed about the extra 150 odd mA load on this wind-ing. The use of a 6-volt .15 ampere dial lamp would bring the total load to just on 2 amperes, but you can please yourself which size you use.

With the set completely wired, the next step is to align the tuned cir-cuits. Assuming that the dial pointer travels to its extremities in step with the "full in" and "full out" positions of the gang plates, adjust the posi-tion of the oscillator coil slug until a selected station at the low fre-quency end of the dial, say around the 600 Kc mark (which in Sydney would be 2FC), falls on its appro-priate position on the dial. Adjust the aerial slug for maximum volume from this station.

TRIMMER ADJUSTMENT

Swing down toward the high fre-quency end, peak the aerial trimmer and observe whether the stations fall on their correct positions on the dial. Correct any discrepancy in this respect by adjusting the oscilla-tor trimmer. For each adjustment of the oscillator trimmer re-peak the aerial trimmer for maximum volume.

Finally, check the situation at the low frequency end of the dial. If any adjustment is found necessary, re-check the high frequency end. Carefully peak for maximum volume the two slugs on each IF trans-former and the job is done.

The remaining job is to fit the set into the cabinet. You can work either by measurement or by cut-ting a template out of suitable card of the front of the set and laying it against the inside of the cabinet front. The latter method is easier and less susceptible to error.

The dial lamp and holder extends a little beyond the face of the dial glass and should be let into the

(Continued on Page 77)

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PF 119	240	6	325	125	6.3V @ 4A	102/5
PF 182	240	12	200	40	12.6V CT @ 1A	61/5
PF 126	240	12	250	60	12.6V CT @ 1A	71/11
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A	120/9

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CF 101	30	870	25		33/-
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CF 103	30	420	60		48/2
CF 104	30	580	75		51/2
CF 105	15	250	80		43/1
CF 106	12	200	100		43/8
CF 107	30	360	100		59/2
CF 108	12	135	150		61/7
CF 109	20	225	150		64/3
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CF 111	16	165	200		74/8
CF 112	10	70	250		74/8

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CF 115	.017	.6	2 amps	L.T. choke	22/6

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OP19A	5000 PP	12.5, 8, 2.3	15	163/5
OP51	4500 PP	15.5, 12.5, 8.6, 2.7, 2	20	153/3
OP63	10000 PP	15, 3.75	15	174/6
OP64	10000 PP	12.5, 3.125	15	174/6
OP65	10000 PP	8.4, 2.1	15	174/6

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OP25/40	10000 PP	40, 10	15	183/4
OP25/16	10000 PP	16, 4	15	183/4
OP25/15	10000 PP	15, 3.75	15	183/4
OP25/12	10000 PP	12, 3	15	183/4
OP25/10	10000 PP	10, 2.5	15	183/4
OP25/8.4	10000 PP	8.4, 2.1	15	183/4
OP66	5000 PP	8.4, 3.7	15	219/6
OP67	5000 PP	15, 6.5	15	219/6

OUTPUT TRANSFORMER TO LINE—

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OP22	3250 SE	500, 125, 2.3	10	112/3
OP19b	5000 PP	500, 250, 125	15	163/5
OP21	8000 PP	500, 250, 125	15	133/6
OP62	10000 PP	500, 125	15	174/6

OUTPUT TRANSFORMER TO LINE—

Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	183/4
OP25/250	10000 PP	250, 62.5	15	183/4

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VT 104	6	250	60	.005	,,	50/2
VT 105	12	250	60	.005	,,	51/11
VT 106	6	300	75	.008	,,	82/10
VT 107	6	250	60	.005	Sync. Low Rad.	54/10
VT 108	12	90	15	.008	Sync.	41/5
VT 109	24	90	15	.008	,,	43/9
VT 110	12	150	25	.005	,,	49/-
VT 111	24	150	25	.005	,,	53/8
VT 112	12	200	50	.005	,,	51/4
VT 113	24	200	50	.005	,,	51/4
VT 114	12	300	75	.008	,,	89/3
VT 115	24	300	75	.008	,,	90/3
VT 116	24	250	60	.005	,,	57/2
VT 117	12	250	60	.005	Non Sync. Low Rad	55/5
VT 119	32	150	25	.005	Sync.	49/2
VT 121	6	180	30	.005	,,	51/4
VT 122	6	400	50	.005	,,	83/10
VT 123	12	320	125	.005	Sync.	107/10
VT 124	32	250	60	.005	,,	56/-
VT 127	6	200	50	.005	Sync. Low Rad.	51/4
VT 128	12	250	60	.005	Sync. Low Rad.	60/8

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	30	6.3V @ 2A	50/2
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	53/11
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	50/2
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	60/8
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	66/6
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	72/2
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	69/5
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	77/9
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	87/3
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	97/6
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	109/2
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	102/5
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	127/9
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	197/9
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	185/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3V @ 3A, 5V @ 3A	243/7
PF 201	240	225	50	6.3 @ 2A	51/1

LINE TO VOICE COIL TRANSFORMERS

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MT111	500	12.5, 8, 2.3	10	69/1
MT100	600	4, 3	15	64/2
MT101	500	15	15	64/2
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	107/10
MT125	600, 500	15, 12.5, 8.4, 6.5	25	105/2

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	169/4
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	195/1
MT120	500 to 20000 in steps.	500 to 30000 steps.	50	356/10
MT121	500 to 20000 in steps.	500 to 30000 steps.	125	444/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	71/3
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	10	82/3
OP39	5000, 2500 SE	15	10	72/6
OP33	5000, 2500 SE	5, 2.7	10	72/6
OP41	5500 SE	3.7	10	81/1
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	70/4
OP2	5000 PP	12.5, 8, 2.3	15	109/11
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP3	6600 PP	12.5, 8, 2.3	15	109/11
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP4	10000 PP	12.5, 8, 2.3	15	109/11
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	109/11
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	121/11
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	152/9
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	32	195/-

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	71/3
OP44	5000, 2500 SE	500, 250, 125	10	84/8
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	131/-
OP6	5000 PP	500, 250, 125	15	109/11
OP7	6600 PP	500, 250, 125	15	109/11
OP50	8000 PP	600, 300, 120, 60, 30	15	228/4
OP8	10000 PP	500, 250, 125	15	109/11
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	118/6
OP9	10000, 6600, 5000 PP	500, 250, 125	15	109/11
OP10	5000 PP	500, 250, 125	25	132/6
OP11	6600 PP	500, 250, 125	25	132/6
OP38	6600 P	600, 300, 250, 200, 170, 150 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	25	228/4
OP12	10000 PP	500, 250, 125	25	132/6
OP13	10000, 6600, 5000 PP	500, 250, 125	25	132/6
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	187/4
OP14	5000 PP	500, 250, 125	32	161/-
OP48	6600 PP	140, 70	32	195/1
OP15	6600 PP	500, 250, 125	32	161/-
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	162/6
OP16	10000 PP	500, 250, 125	32	161/-
OP17	10000, 6600, 5000 PP	500, 250, 125	32	161/-
OP36	3800 PP	17.6	60	171/-
OP18	3800 PP	500, 250, 125	60	173/4
OP61	3800 PP	100, 75, 50, 25, 10, 5, 2	60	223/-
OP37	6400 PP	500, 250, 125	80	236/3
OP49	8800, 6000 PP	500	105	355/10
OP20	11600, 8400 PP	500, 250, 166, 125	150	451/-

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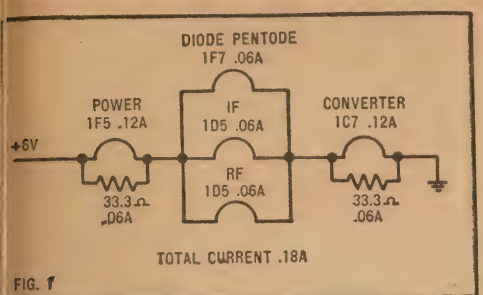
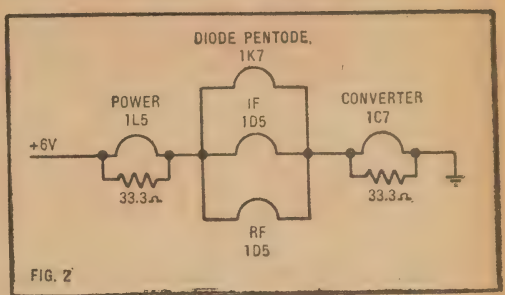


After much calculation the original filament circuit was worked out as that shown above.



The filament set-up of the set as received. The substitution of the 1K7 and 1L5 valves completely upset the current distribution.

In case you think that mathematics and formulas are intended only for the cap and gowned professors, let me assure you that the humble serviceman has often to reach for paper and pencil and resort to calculations to solve his problem.

A CASE in point was a recent vibrator set which came my way. In the normal course of events I see very few of these, for they are essentially a country radio. However, this one belonged on a small private yacht and, when the owner mentioned it to me, I had visions of corroded IF windings and all the terrible things which are supposed to happen to sets exposed to the salt air.

I was agreeably surprised therefore when the set was duly delivered to the shop and proved to be in good condition. Not only was the chassis free from rust and corrosion, but it transpired that all the coils were intact. This must reflect some credit on the makers, for the set had been standard equipment on the boat for several years.

POOR PERFORMANCE

The whole set-up had only recently been acquired by the present owner, who complained that the performance of the set had steadily deteriorated over the few months that he had had it. He also admitted that he had tried to improve matters by aligning the IF transformers, but had only succeeded in getting things hopelessly messed up.

The set was designed for use with a six-volt battery, with directly heated filaments of the two-volt type in a series-parallel network.

There was an RF stage, making five valves in all. A set of this type could be expected to have excellent sensitivity but, on test, it showed up very poorly. In spite of the RF stage, it would barely receive the more distant locals, the power output was limited even for its type and there was some evidence of hum.

Knowing that the alignment had been tampered with, I decided to put this to rights first, and in the process get some idea of the overall sensitivity.

But it was not as easy as all that. The trimmer across the second IF primary had a stripped adjusting screw, so that the winding was tuned about 30 Kc higher than the first IF. Matters were not improved by the secondary being set to the same frequency, whether by chance or otherwise I do not know, and the result was two response peaks 30 Kc apart.

A new screw in the trimmer enabled it to be tuned to the correct frequency and, with the rest of the channel tuned up and a rough adjustment made of the gang trimmers, the set was certainly more lively. But it was still poor for a set of its size and, by measuring stage gain with the signal generator, I concluded that most of the loss was in the converter.

A voltage check around the socket revealed nothing until, almost as an afterthought, I measured the filament voltage. I must admit that I was too surprised to note the exact value, but it was nearer three volts than two, and I realised that the whole filament network would have to be checked.

VALVE TYPES

First step in this direction was to check the valve types, which turned out to be a 1D5 RF amplifier, 1C7 converter, another 1D5 IF amplifier, a 1K7 diode-pentode, and a 1L5 power output. I must admit I am not too familiar with the characteristics of these battery types, so there followed much searching of valve data sheets and listing of the filament current ratings.

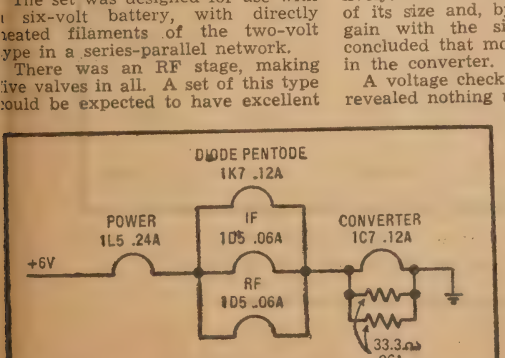
Then I checked the type numbers on a small sticker on the back of the chassis, which was no easy task for this was one thing the salt air had affected. However, it was eventually deciphered and the types listed as 1D5's in the RF and IF stages, 1C7 converter, 1F7 diode pentode, and 1F5 power output.

It was beginning to become clear what had happened. The original 1F5 and 1F7 had failed, and being in short supply, had been replaced by the nearest equivalents, the 1K7 and 1L5.

FILAMENT WIRING

It is true that these types are very similar and, in many cases would be directly interchangeable. However, in series filament nets works, the filament currents must be the same before valves can be substituted, and these types are quite different in this respect. (More data sheets!) The original 1F5 power valve passes .12 amp., while the substitute 1L5 is rated at .24. Likewise the original 1F7 passes .06, while the 1K7 rating is .12 amp.

So much then for the valve types. It was now necessary to check the



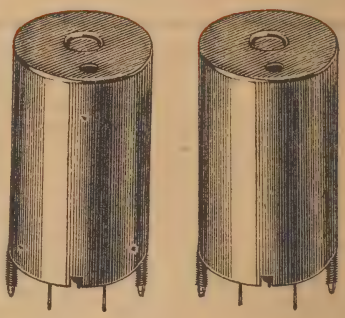
★

How the circuit was finally modified to accommodate the altered valve types. In this case it was not even necessary to wind a new shunt.

Both Alike

but such a difference

Here at "Q Plus" Laboratories we have recently been conducting tests between various other coils I.F.'s, etc., obtained from manufacturers' distributors overseas, etc., to prove that we at "Q Plus" were offering you "Pound for Pound" value in your purchases. Many coils look alike, but those extra stations from distant parts come FREE to the more sensitive coils.



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FEATURES	Q-PLUS A.C.5.	Q-PLUS A.C.4.	COIL 1	COIL 2	COIL 3
PERMEABILITY TUNED	YES	YES	YES	YES	YES
"Q" of sec. at 500 Kcs	176	110	110	110	124
Coil Gain at 600 Kcs	9.75	6.5	5	6.5	7.00
Coil Gain at 1500 Kcs	13.5	11.00	4.5	4.5	5.00
Spheroclad Construction	YES	NO	NO	NO	NO
Coupling "K"	Optimum	Optimum	Under	Under	Optimum

These results were checked with a Marconi Circuit Magnification Meter and a specially designed test chassis for gain test and the results are vouched for.

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ament wiring and find what steps, any, had been taken to accommote the alternative types. Furtherore, if steps had been taken, nether they were incorrect, or had iled due to a faulty component.

Of course it is easy to write, "I ecked the filament wiring," but e actual job can be a major underking. For one thing, it is usually e first wiring on the chassis, so at all other wiring and components e on top of it and, in a mantel-size t, this renders it inaccessible to y the least.

There is also the fact that the laments must be wired in correct quence for bias, and not necesrily in the normal order. Thus one often forced to trace the line back nd forth across the chassis while ying to avoid getting mixed with her wires going in the same direcon. Color coding of the wires would elp, but not everyone thinks of e poor old serviceman.

Anyway, the job was eventually ompleted and I had a very rough encil sketch, which meant the same hing as figure 1. When I applied t the original filament ratings was at once obvious that nothing ad been altered when the new alves were fitted.

WIRING CHAIN

In its original form, the total curent through the circuit would have been .18 amp., and the manner in which it divides is rather interesting. find these things easier to grasp f the various parallel networks are livided into separate groups.

The first of these is the 1C7 with he 33.3 ohm resistor. The former will pass .12 amp. and the latter .06, making a total of .18.

Next is the group of three filaments in parallel and, as each of these passes .06 amp., the total will also be .18.

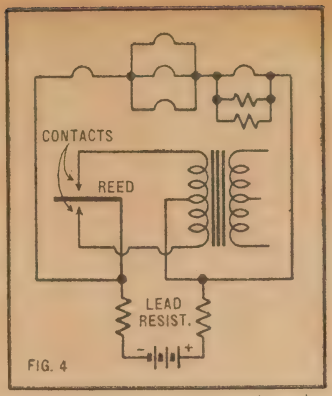
Finally the power valve with another 33.3 ohm shunt provides a similar set of conditions to the 1C7, and will also pass .18 amp.

However, this ideal set of conditions no longer remained. The 1K7 and the 1L5 both pass more current (or have less resistance) than the valves they had replaced, and the resistance of both groups would be lowered by their substitution (fig. 2).

With the resistance lowered, the voltage applied to these groups would also be lowered, which meant that four of the five valves had been working at reduced voltage. But since there was still six volts applied to the whole circuit, a decrease in one part must mean an increase somewhere else—in this case across the 1C7.

BAD BALANCE

It was not hard to see how all this mix-up had ruined the performance of the set. The under-rated filaments would result in poor sensitivity and power output, while the over-rated 1C7 might have performed a little better than normal for a few hours, after that it would be on the way out! After about three months of this it could hardly raise a flicker on the emission tester and, indeed, it was a wonder that the circuit continued to oscillate.

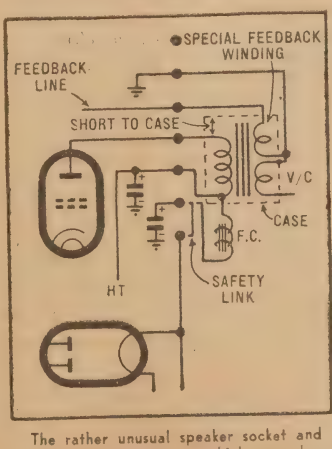


This is the filament network and vibrator supply primary reduced to the simplest terms. It is not hard to see how the extra resistance will cause hum.

Having gathered all this wealth of information, I was now faced with the problem of modifying the circuit to suit the existing valves. The central group of filaments seemed to offer a clue, the total current required being .24 amp., the same as that for the power valve without a shunt, leaving only the 1C7 to be shunted for excess current.

I was quite prepared to wind a new shunt to the required resistance, but a further stroke of luck saved me the bother. The 1C7 requires .12 amp., so that the shunt would also have to pass this value to equal the .24 amp. through the rest of the circuit. It was already shunted by 33.3 ohms which would pass .06, so that another shunt of the same value was all that was required, and this was the value of the shunt to be discarded from the power valve.

So all I had to do was remove the shunt from the 1L5 socket and connect it in parallel with the existing one across the 1C7 socket—a job requiring only a few minutes. As is usually the case the real work had already been done in finding the fault and devising means of correcting it. (Yet some people still say: "He charged me — shillings just to move that thing from there to there." Preposterous, I calls it.")



The rather unusual speaker socket and feedback arrangement which caused a mild headache. The 7 large dots represent the speaker plug and socket connections.

With a new 1C7 installed, the sensitivity was really good but the power output was still limited and the reproduction rather thin. I suspected a weak second electrolytic which often causes similar symptoms, and checked this by placing a new one between the HT line and earth. Most of the hum disappeared and the response improved considerably, indicating that there was a high impedance to audio signals through the power supply, which normally provides the return path.

It is not good practice to leave a faulty electrolytic in circuit, as it may short at a later date, and I began searching for this one to remove it. Not finding it on the main chassis I turned to the vibrator box, but this only contained the first electrolytic, so I returned to the chassis. A more careful examination finally disclosed where it had been, as indicated by two short lengths of what had once been the pigtails. I can only assume that it had shorted, and that someone, discovering the set would play without it, had never bothered to replace it.

HUM LEVEL

With the new condenser in circuit the general performance was extremely good and I decided that after a final alignment check it could go back in the cabinet. But as I upended the set, the hum level suddenly increased quite noticeably and continued to vary in an erratic manner as I moved the chassis. After some experimenting I found that movement of the battery cable caused the variation, so set about checking this item.

It was a shielded cable, with the outer braid forming the negative conductor. The inner conductor consisted of two lengths of hook-up wire, connected in parallel to reduce resistance and voltage drop, and testing each of these separately showed that one had an intermittent break.

By carefully stripping the braid I was able to replace both wires with two lengths of light flex, which was not only slightly heavier than the original, but also contained more strands of finer wire, so there was less chance of a break in the future. This done I was able to really complete the alignment and fit the chassis back in the cabinet.

Just why an increase in the battery lead resistance will cause hum is perhaps not easy to see but, on studying the operation of a vibrator supply, this point becomes clear. In figure 4 is shown such a supply, reduced to the simplest possible terms and with the effective lead resistance shown as actual resistors.

THE VIBRATOR

If we assume that at a particular moment the reed is between the two contacts, then the drain on the battery will be that of the filament network alone. However, when the reed

(Continued on Page 79)

Let's Buy An Argument

The process of forming mental pictures is a natural one for most people when studying a technical subject and particularly radio. However, these mental pictures are not always complete, and can lead to erroneous conclusions. Inevitably, there comes the time when more rigid mathematical analysis has to be added in the interests of accuracy.

by W. N. Williams

BY the term "mental pictures," I am trying to define the process which most of us — including myself — very frequently assimilate a theory or explanation which is new to us.

We try various approaches until we discover a familiar line of thought. Thus heartened, we proceed to develop a logical sequence of mental pictures which both explain and portray the particular probem. If, at a later date, figures and formulas can be hung for reference in the mental gallery, so much the better.

MENTAL PICTURES

From the ranks of the "mental picture" boys come the best lecturers or should we say the best elementary-lecturers. Having found it necessary to sort out ideas and images in their own minds, it comes as no great burden to transfer them to the blackboard. However, that is only incidental.

By contrast, the pure mathematician — a fairly rare specimen — prefers to think initially in terms of figures and formulas. He may never even consider it necessary to tabulate his ideas in any other form and, as a result, finds it difficult to communicate his knowledge to others who do not share his propensities.

I recall, in particular, one learned gentleman whose reaction, when confronted with a problem, was to reach for a pad and proceed to fill it with an imposing array of functions and notations. Long before he got to the last "equals" sign, the problem was already resolved in his mind and anyone who failed to grasp the implications of his figuring was relegated immediately to the "imbecile" class.

The fact that he, himself, was erratic and impractical by ordinary standards and completely hopeless as a lecturer, entirely escaped his notice.

Not that I would disparage the "impractical" mathematician for the moment. He is an essential member of any research team. He will often come to the rescue when the "practical" man has reached his wit's end. And, what is more, he can often proceed to conclusions and results, unhampered by the present lack of the ways and means to achieve them in practice.

Without his watchful eye, many of the mental pictures we lesser mortals build up would lead us into error. Take the process of modulation, for example, plain ordinary amplitude modulation.

AMPLITUDE MODULATION

It seems so simple on the surface. You set up an RF power amplifier, probably in the last stage of a transmitter. It is operating initially with a certain plate voltage and current and is delivering a certain amount of RF power to the aerial.

Impulses are then applied to it from an audio source. During part of the audio cycle, the plate voltage of the RF amplifier is increased. Its plate current rises, as a result, and up goes the RF power output. During the rest of the audio cycle just the reverse happens.

The product, very simply and very obviously, is the familiar modulated RF envelope, which most of us can draw in our sleep. What's wrong with that? Well nothing much, except that one can produce from it an immediate contradiction. "S'easy," as they say in the classics.

THE RECEIVER

According to our envelope pattern, the process of modulation merely involves a variation in carrier amplitude. There is no hint that it affects frequency. In fact, we may conceivably have been told that frequency shift is a bad thing with amplitude modulation.

At the receiving end, variations in carrier amplitude with modulation should fundamentally be no different in effect than a rapid variation in

rial coupling or RF gain — or ything else that will produce a rise d fall in the signal at the detector. urely a question of amplitude, rely?

Right then! We proceed to tune in amplitude modulated signal and scover that fidelity is affected mehow by selectivity. The higher odulation frequencies get trimmed f by sharp tuning circuits. How me? If we are concerned with only e signal frequency, it shouldn't atter how rapidly some gink at the her end varies the amplitude.

I find personally that the mental cture approach breaks down at this int. I have to accept mathemati- l assurance that the process of nplitude modulation does involve e production of additional fre- encies called "sidebands." In fact, e power fed in from the modulator absorbed in their production.

IDEBANDS

I am further assured that the im- sition of a modulating frequency Fm" on a carrier "Fc," produces vo distinct sidebands equal to Fc lus Fm and Fc minus Fm. The same olds for every single modulating equency component, which may appen to be present. In fact, you n easily modulate a carrier with a ngle tone and actually tune the debands.

As a result of all this it becomes ecessary to instal the sideband nage alongside the envelope image ithout, I am afraid, there being uch link between them other than athematical assertions covering ntermodulation and heterodyne ffects.

The modulated envelope pattern is alid enough, as far as it goes (you an even see it on a C.R.O.) but you an't afford to leave the matter rest here. It is necessary to realise that modulated envelope does not exist space as a simple entity but is e summation of a specific pattern f carrier and sidebands radiated y an AM transmitter.

As someone has remarked, "you an't go paddling without getting et feet." Neither can you amplitude carrier without producing side- ands at distinctly new and different equencies.

M LIKEWISE

Much the same remarks apply for equency modulation. It seems such simple matter to vary the fre- uency of an oscillator by modifying ne apparent value of a shunt apacitor. "Just varying the fre- uency," one might explain. Such a imple statement.

It reminds me of an occasion at chool when the science master ueried my activities. "Just mixing hree harmless chemicals," I ex- lained. "But you're making gun- owder," he retorted. As it transpired, e were both right!

So it is with FM. "I'm varying ne frequency" says the constructor. But you're producing sidebands" ay the mathematician—and they're oth right. A frequency modulated ansmitter does indeed produce a pecific pattern of sidebands, all of which must be admitted and dealt with by the receiver. If they are not, then amplitude distortion will occur.

My mental imagery doesn't cover this too well either.

But phase modulation really puts the custard on the pudding, because it apparently affects neither the amplitude nor the frequency of the outgoing signal. Perhaps that's the reason for some rather crazy claims in partly-informed circles. Let's look at the matter.

In a PM transmitter, the reactance modulator tube is normally connected in parallel with the tank circuit of one of the buffer amplifiers. In effect, it detunes the circuit rapidly to either side or resonance in sympathy with the modulating signal.

This detuning process alters the phase angle in the particular circuit and has the effect of accelerating momentarily or of retarding the flow of RF cycles through the stage. It becomes evident that a periodic variation in the time interval between successive RF waves is equivalent to a variation in frequency. Hence the close relationship between phase modulation and frequency modulation.

PROPORTIONS

But there is one important difference between FM, as accomplished at the oscillator, and the FM effect as accomplished by phase angle in a buffer stage.

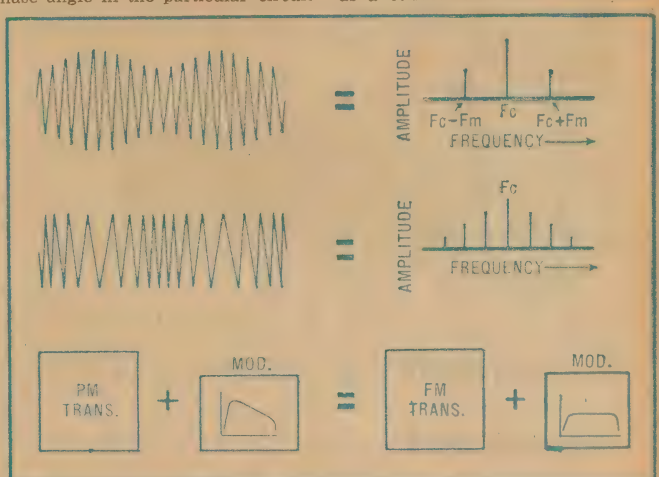
In the first case, the amount of frequency deviation is dependent only on the amplitude or strength of the modulating signal. With so-called phase modulation, the frequency deviation is proportional to both modulation amplitude and the modulating frequency.

In other words, a 3000-cycle note will deviate a PM signal considerably more than a 100-cycle note, whereas, with true FM, the deviation would be the same.

As a result, the phase modulation process is frequency conscious and produces a response which rises with frequency. Heard in an FM receiver, or under the same conditions as an FM signal, a simple PM signal would sound very high pitched.

To impart a flat deviation-to-frequency characteristic to a PM signal would require treble cut in the modulator to match the rising modulation characteristic. This must not be confused with sharp cut-off filters which are used for an entirely different purpose.

But, other things being equal, the provision of the requisite slope filter to impart a flat or a predetermined pre-emphasis characteristic to a PM signal, gives it exactly the same frequency-deviation law as a conventional FM transmission.



Illustrating a few observations about modulation methods. The tie-up between phase modulation and frequency response is worthy of special note.

It will have the same sideband distribution and will, in fact, be the same signal!

The method adopted to achieve that result is entirely a matter of preference and convenience.

But it is silly to suggest, as I have heard it suggested, that a PM signal is easier to receive than an FM signal.

Personally, I find it very difficult to pick the difference between lemon cordial and cordial made with lemon. "Nuff said."

OTHER IDEAS

Discussion of matters pertaining to RF reminds one that there are plenty of cranky notions associated with this part of the spectrum.

One that seems to crop up again and again concerns broad or "unselective" oscillators. It comes in many forms, like so:

1. I have built a test oscillator but the signal is very broad. Even without modulation, it spreads badly on the receiver dial. How can I make it sharper?

2. I admit that a BFO is essential

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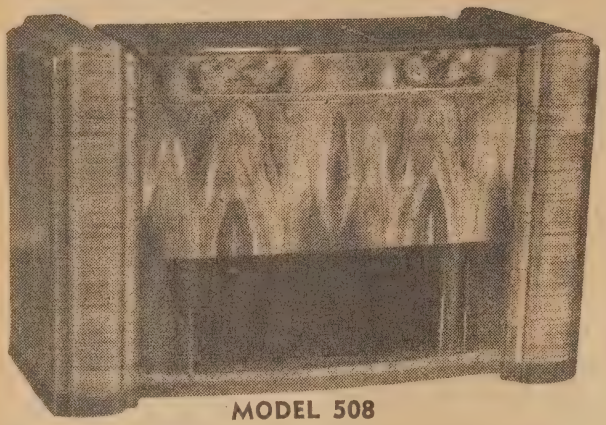

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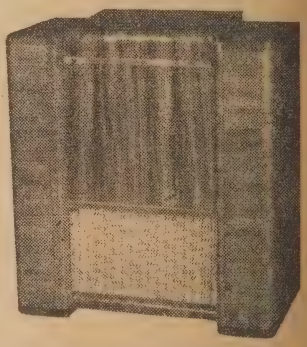

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a "Ham" wants to work DX but signal is not nearly as sharp as m a good crystal oscillator.

3. The oscillator coil in my set wound with ordinary wire. ouldn't the set be a lot more ective if I were to substitute a -wound coil?

Strangely enough, this last ques-n isn't confined to readers' queries. have heard it advanced recently two well-known technical per-alities. They spoke quite seri-sly about "broad" and "sharp" illators.

Behind the examples quoted there y indeed be a half-truth but it esn't alter the fact that the idea non-selective oscillators is basic-y fallacious.

NE FREQUENCY

A simple oscillator can produce ly one fundamental frequency at particular instant and that fre-ency is determined by the phase lationships through out the oscil-ory circuit. It may involve one lve or several and specific quan-ies of L, C, and R both seen and seen.

If the combination of all these ements is "resonant" at 1000 Kc en the fundamental output will be 1000 Kc only. There will be no ultaneous output on 999 Kc or 01 Kc and it therefore makes no fference whether the output is ken directly from the oscillator or rough a string of tuned amplifiers.

It is quite true that you may hear e signal over a substantial part of receiver dial but this is entirely function of receiver selectivity. e signal is still on 1000 Kc only, en though the dial blandly says 0 Kc.

Herein lies the explanation of road" unmodulated test oscillators. the signal reaching the receiver is cessive either by leakage through e case or the attenuator, then the nal will appear to spread simply cause it swamps the receiver tun-g circuits.

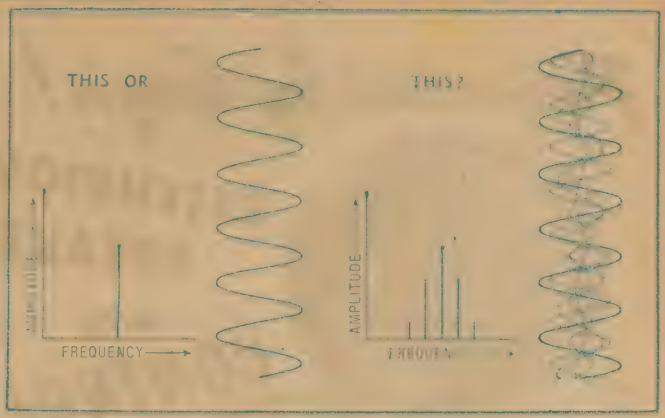
NOTHER CIRCUIT

Substitution of another oscillator, tably a negative transconductance pe, may conceivably reduce the RF nplitude and may therefore inject ss signal to the receiver. It may en appear to be sharper but ap-arances in this case are completely ceiving.

Of course, the moment modulation applied, the signal might again pear to become broad. With poor sign — and most modulated cillators are poor in this respect the modulating voltage may cause e signal frequency to swing at an dio rate, producing a spreading fect even on a selective receiver.

But the original observation holds od, in that the RF oscillator still oduces one frequency only at any rticular instant. If we proceed to ing that frequency up and down accident or design, we can hardly onder at the result.

Much the same holds for an nateur transmitter. A crystal cillator is normally fairly proof against temperature and voltage variations and for all practical purposes, its output remains rock steady.



The sketch on the right is intended to illustrate the non-existent "broad" oscillator. We prefer to stick to the one on the left.

The same cannot always be said for VFO's which may exhibit slight frequency swings as a result of hum or modulation ripple or even variable loading on the output circuit. Call the effect "broad" if you like, but please understand that it is due to rapid frequency swing and not to some fantastic "broad-band oscillator" effect.

Then there's the one about the receiver oscillators. Assuming that the oscillator is fundamentally stable. it can produce only one fundamental frequency. This will beat with all the available input signals to produce a variety of output frequencies. It's entirely up to the signal circuits to determine how many inputs will be available, while the IF channel will determine how many of the beat frequencies will get through to the detector.

The oscillator coil has absolutely nothing to do with the fundamental selectivity of the set.

But here's one of the half-truths I have referred to. A poor oscillator will produce a range of strong harmonics in addition to the fundamental and these harmonics can conceivably beat with stray input signals or RF components to produce beats or "birdies."

Some designers therefore, counsel the use of high "Q" oscillator circuits to minimise troubles of this nature. But it has nothing to do with "broad" oscillators and selectivity in the usual sense of the term.

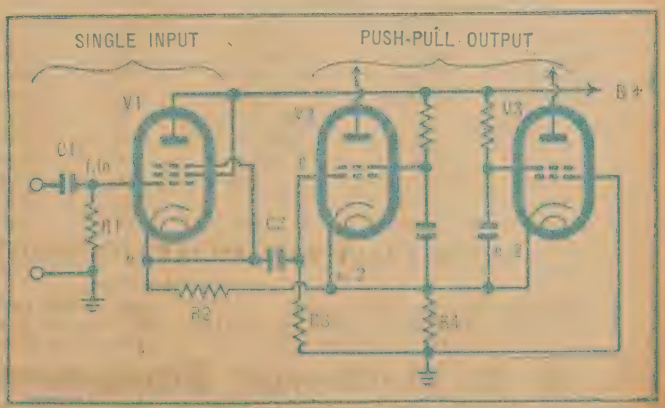
PUSH-HALF-PULL

My slighting reference to "push-half-pull" circuits in the last issue brought forth a retort from Mr. Hardy of East Malvern, Vic, in the form of a circuit published in the M.I.T. Radiation Lab. series. The idea, which is new to me, is illustrated below.

Mr. Hardy concludes, "I would appreciate your comments on this, as I had been hoping to save myself the cost of a phase inverter."

A complete analysis of the operation would involve a lot more space and time than is available at the moment but a spot of "guesstimation" might do instead.

(Continued on Page 96)



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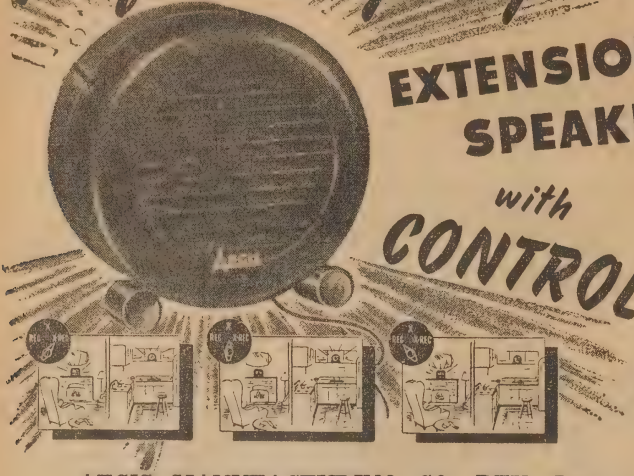

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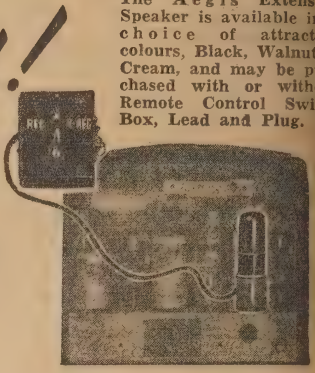

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IT511-10	50	100,000	+18	Mic. or line to Single or P.P. Grids
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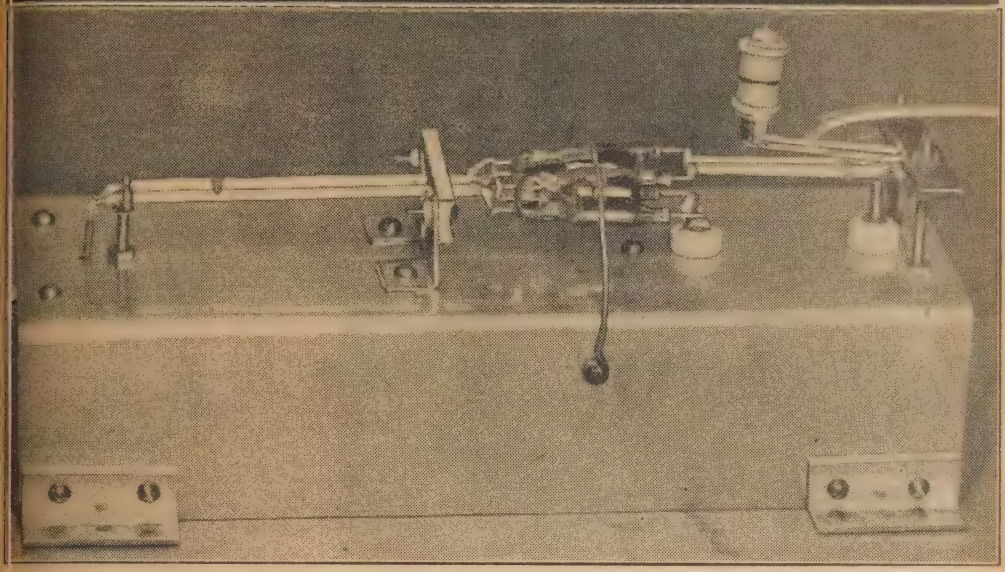
TRANSMITTER ON 576 MEGACYCLES



his side view of the oscillator shows filament lechers at left, RL18's in the centre, plate and aerial lechers at the right. The latter re clamped between two fibre strips. Hoop of wire round the valves protects them from possible damage. Valve pins are soldered directly to circuit points. Grid and plate connections run under the chassis through insulating bushings.

More and more amateurs are pushing on into the higher frequencies, and experimenting with the band around 576 megacycles — about the highest we can go without special equipment. Fundamentally there is nothing really difficult about this band, once the idea of miniature circuits has been mastered.

THE 576 Mc band is much the same today as was the 50 Mc band before the war. Modulated oscillators are mostly used for transmitting, and super-regenerative receivers for reception. A few more fortunate ones have acquired superheterodynes of the ASB series, which operate very well.

The purpose of this article is to examine the behavior of a simple transmitter, together with its aerial system and field strength meter, so that those who are interested may find their way to the band without too much difficulty.

In subsequent issues we may be able to follow the same procedure with receivers, thus completing the equipment necessary to operate a station.

SIMPLE CIRCUITS

As time goes on, it is likely that more elaborate designs will be evolved with appropriate improvements in results, but at the moment it is not likely that the average man will have the facilities to make up anything but simple circuits.

Not many valves available to amateurs are useful for transmitting at 576 Mc. At this extremely high frequency, a half-wavelength is about 3 inches long, which means that even a half-inch length of wire has appreciable reactance in a circuit. No valves using conventional bases are of any use. Suitable valves invariably have short pins, which run away from the valve elements in straight lines. The elements inside the valves are also kept small and the spacing between them reduced as much as possible to reduce transit time—the time it takes electrons to travel from cathode to plate.

Experience has shown that the best valve generally available for this band is the RL18, a wartime type made specifically for these frequencies with an upper limit on part ratings of 600 Mc. The Acorn, more especially the 955, is also useful, and with care the 6J6 can also be made to oscillate. The RL18, however, has the grid and plate leads coming through one end of the envelope and the filament and cathode through the other. This makes it particularly suitable for line oscillators.

by John Moyle

These valves will give an appreciable output at 576 Mc—appreciable in the sense that it is enough with beam aerials to make good contact over quite a few miles. Each has an input power of about 2.5 watts, so that two of them in push-pull will run about 5 watts. Only a small portion of this is available as output power, because of the low efficiencies brought about by losses which are difficult to avoid at such a high frequency.

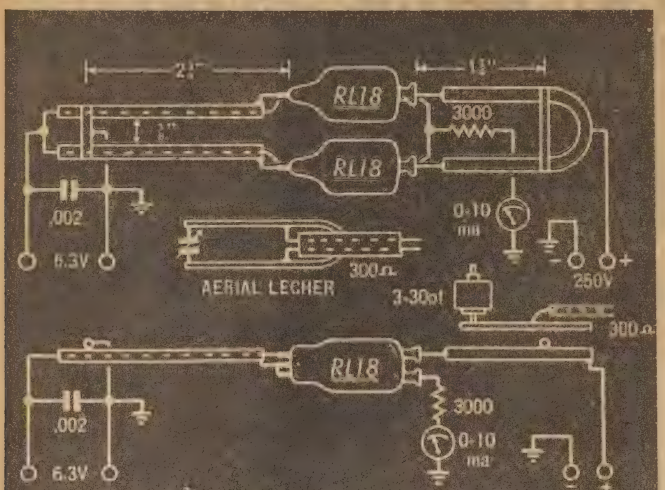
RESONANT LINES

Tuning coils are not used at 576. In their place, sections of resonant lines, such as parallel lechers or co-axial lines, are employed. When connected in circuit, the pins of the valves become virtually portions of these lines, which means that the actual ends of the lechers are right inside the envelope at the valve elements themselves. The pins are therefore no longer mere connections to an external circuit—they are part of that circuit.

This is an important point to bear in mind when considering valve operation at 576. The principle is used even at lower frequencies for the same reasons.

A glance at the circuit-schematic diagram of the little transmitter will make this point quite clear.

CIRCUIT OF 576 MC OSCILLATOR



This schematic shows a plan and side view of the circuit plus a plan sketch of the aerial lechers. With the photograph on page 65 it gives all the information required. The grid leak is under the chassis.

When considering transmitter design, it becomes immediately obvious that a straight oscillator is the only way to start without great complications. The normal practice of commencing with a low frequency crystal or other stable oscillator and multiplying up is quite difficult, although it could be done with a whole string of multipliers requiring critical adjustment because of their low efficiency.

PUSH PULL CIRCUIT

Perhaps the best all-round design would be an oscillator-amplifier transmitter. This arrangement would give much better stability than a simple oscillator, but requires more hard-to-get valves and introduces problems. There is no real objection, and many advantages, in starting with a straight oscillator as a means of becoming familiar with circuit constants, layout, &c., and their peculiar adaption to the frequency used.

Although quite a few amateurs use a single RL18 oscillator, the push-pull circuit is best, not only for the standard reasons in favor of push-pull circuits, but because of the higher power obtainable. After all, 2.5 watts isn't much input, particularly when only about 10 pc or thereabouts is likely to be usable as output.

The circuit used here is a standard type, which experience has shown to be reliable and stable. It is tuned to frequency by adjusting the shorting bar at the end of the tiny little anode lecher, which is essentially one-quarter wavelength long electrically. The cathode-filament lines are not "tuned" in the same sense, but are there to raise the cathodes above earth, and to maintain the filaments at the same potential as the cathode.

This is done by earthing one set of filament pins through the lechers themselves and running the other set through the lines to the remaining filament connection. Lightweight insulated bellwire we found would just slip through the centre of the one-eighth inch tubing.

Operating Data—RL18

at 400 megacycles.

Heater voltage	6.3v
Heater current	0.25a
Plate voltage	200v
Plate current	12.5ma
Grid current	3.6ma
Plate dissipation	2.5 watts

In short periods valves are often operated at 600 mc with 300 plate volts with increased output if grid current is not exceeded.

The grids are connected together and return to earth through the grid meter and bias resistor.

The construction of the oscillator is absolutely symmetrical in order to provide a perfectly balanced circuit. This is important and means that the lines should be kept as far from any other objects on the chassis a possible.

The circuit-schematic diagra shows plan and elevation drawin to give better detail, plus a sma separate plan of the aerial leche We have shown the distances fro both shorting bars to the actual gla of the valves to indicate rough where these should be placed to tu 576 Mc. The exact positions will d pend on small variations in lir spacing, &c.

SOLDERING TO PINS

Although there is some danger cracking the glass we soldered th valve pins directly into the circu to avoid socket complications. Th is easy to do if the pins are fir scraped clean and tinned by quic spotting with a fairly hot iron. Hol ing them with a pair of long-nose pliers will help to keep the pins fro heating up except for the tips beir soldered. If you work quickly w doubt whether there is much dang of damaging the valves. We hav soldered and unsoldered the valv at least a dozen times without troubl Plate and grid pins are long enoug to solder to the tubing, but the fil ment and cathode pins should use small piece of tinned copper wi for this purpose. Being much shorte they need more careful handling wit heat.

Incidentally, the plate pin of th RL18 is generally identified with red dot on the glass. The cathode the centre pin of the three at th other end.

We ran all wiring below the sma chassis and attached them to a te minal strip at one end for connectio to power supply and meter.

When first testing the oscillat do not use more than about 200 volt preferably less. Do not run th oscillator at higher voltage witho a load such as a pea lamp tappe along the plate lechers. Otherwis the grid current may run too hig and damage the valves.

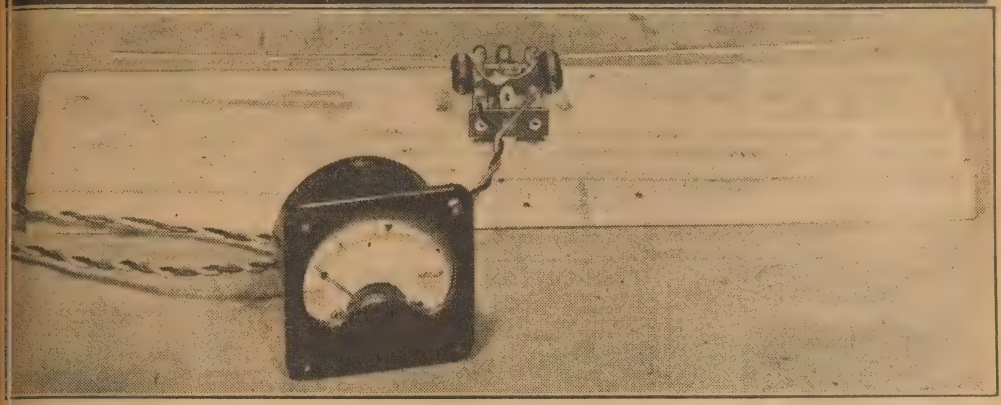
FINDING THE BAND

When attached to the power sup ply it is almost impossible for th oscillator not to work straight awa as indicated by a grid current reac ing. Attachment of the lamp above is a convenient way to sta cut, as, with 200 volts, it should glo A low-consumption lamp is best.

Finding the exact band is some thing of a problem unless you ca borrow an absorption meter from friend or have him listen for you wit a 576 receiver. Fortunately no se vices operate near this band so th you are unlikely to cause interfe ence if not inside it for a sta Attachment of the oscillator to a pa of extended lecher lines made bare wire spaced about a quarter an inch and measuring between gri meter dips is the classic way of finc ing the band and a good one as a experiment. The lines are tapped the aerial lechers and the dips locate by sliding a small screwdriver alon the lines as a shorting bar. If the occur at 9½ inch apart it will b just about 576 Mc.

The aerial lechers represent th best method of connecting the oscilla tor to its load, as represented by th test lechers or an aerial. The ordin

A FIELD STRENGTH METER FOR 576 MEGACYCLES



The field strength meter uses a half wave dipole feeding a GEX-33 germanium rectifier shunted with a small condenser. Replacing the meter with headphones provides a monitor. RF chokes are made of 5 inches of wire wound 3/16 in diameter.

y hairpin coupler isn't much use 576 Mc and you are unlikely to ve much success with it unless the upling line happens to be or is uned to a critical length.

The aerial lecher is actually tuned a quarter-wavelength by the small r-trimmer and bent up or down to ry the coupling to the oscillator. pping the feed line along the aerial cher provides by experiment the int giving the best match. It is ally the only way in which the gree of coupling and matching can adjusted independently.

To make this adjustment, the feedie is soldered or clipped to the rial lecher, which is loosely coupd to the oscillator, and the tuning ndenser adjusted for maximum diation as indicated on the field rength meter described below, or by small lamp to which a dipole of ire has been soldered. This dipole ay need to be about 11 inches long give maximum indication. The ld strength meter is easily the best d most sensitive indicator.

ERIAL ADJUSTMENT

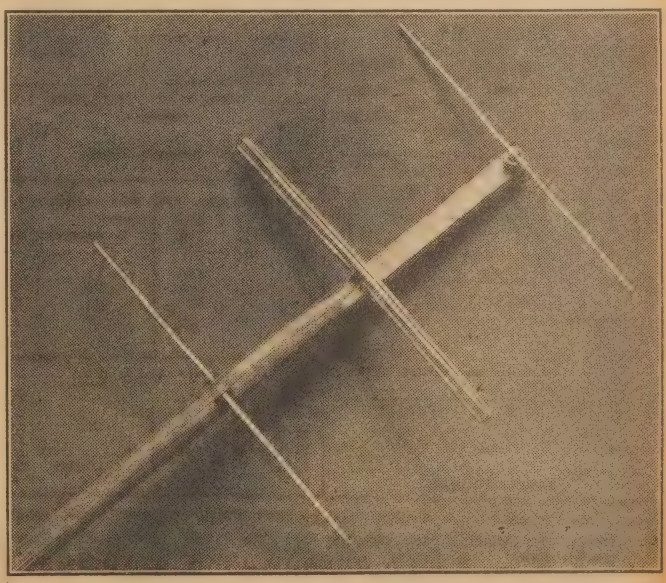
As the condenser is tuned (removg the hand after each adjustment) diation will increase, and grid curnt will begin to fall. At a critical int, radiation will suddenly drop, though grid current will continue fall more or less evenly. Various pping points for the feedline, and rious degrees of coupling of the rial lechers, will reveal a connecon which gives best radiation. When e oscillator is used as a transmitter, d modulated, a setting should alays be used somewhat below this int of maximum radiation to avoid cessive frequency modulation. eavy coupling is not advised with odulated oscillators in the interests a stable signal. Coupling is most nveniently reduced by detuning the rial lechers to the low capacitance de by reducing the capacitance of e tuning condenser.

Coupling to the oscillator will alost certainly change its frequency by an amount determined by the coupling factor, and may call for readjustment of the shorting bar. In fact, almost any adjustment of the oscillator will affect any other adjustment, and the art lies in balancing them all to obtain a stable signal, on frequency, with, say, 60 pc of maximum output.

When you have obtained some indication of output, a shorting bar should be run along the cathode lechers from the cold end. Most probably there will be a slight increase in output, coupled with a decrease of grid current, until a critical spot is found where output drops severely, although grid current continues to drop. The best connection for the bar is just before the output falls off. Readjustment of this shorting bar might be advisable when the transmitter is finally on frequency, and full voltage should not be applied until the best spot has been found for it.

The field strength meter is almost an essential for setting up transmitters and aerials. It consists of a dipole made of wire about 16 or 18 gauge, across the centre of which is connected a germanium diode and a small condenser of about 100 or 250 pf. Two small RF chokes lead away from the dipole for connection to a meter, or a pair of headphones if it is required as a monitor.

(Continued on Page 83)



This 3-element beam is made of ¼in silvered copper tubing. Radiator is a 3-element folded dipole fed with 300 ohm ribbon, its overall length 9½in, and spacing 3/16in. The director measures 9¼in and reflector 10in. They are spaced 4½in from radiator.

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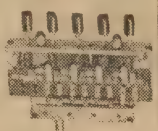

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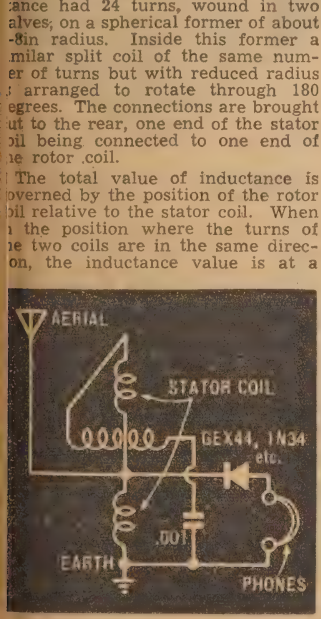
NOVEL CRYSTAL SET WITH VARIOMETER-TUNING

This idea, submitted by a Sydney reader, should appeal to the experimental instincts of the home builder. It is a miniaturised crystal set built around a small variometer taken from a piece of disposals equipment. The overall size, complete with attached dial-type knob, will easily fit into a pocket.

A NUMBER of variometers of all shapes and sizes have been procurable through disposals sources over the past few years, and it is quite likely that many readers have thrown such items into a corner with the thought that some day they may find a use for them.

The variometer used in this instance had 24 turns, wound in two halves, on a spherical former of about 2-3in radius. Inside this former a similar split coil of the same number of turns but with reduced radius is arranged to rotate through 180 degrees. The connections are brought out to the rear, one end of the stator coil being connected to one end of the rotor coil.

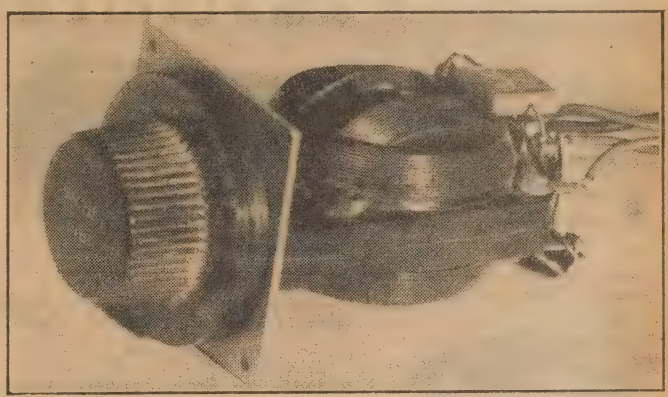
The total value of inductance is governed by the position of the rotor coil relative to the stator coil. When in the position where the turns of the two coils are in the same direction, the inductance value is at a maximum. When the rotor coil is turned fully in the other direction, the inductance value is at a minimum.



With a .001 mfd capacitor connected across the two outside ends of the series-connected coils, it is possible to tune over the broadcast band by slowly turning the knob attached to the shaft driving the rotor coil. The L/C ratio is not the best, and it will naturally follow that, all other things being equal, the volume from this set will not be as good as with a much larger coil and smaller value of capacitance used with the crystal sets described in the magazine over the past years. With variometers having more turns on each coil, a smaller tuning condenser could be used to advantage.

However, the novelty angle is the main theme, and the fact is that with one of these variometers, a fixed crystal detector, a fixed capacitor, a pair of headphones and an aerial and earth system, a crystal set can be "knocked up" in a few minutes.

Note that both the aerial and the detector are connected at the junction of the two halves of the stator coil. This is merely a rough attempt at impedance matching within the practical limits set by the connections to the coils. A little experiment in this direction may prove helpful. Similar provision is made in the larger fixed coils for crystal sets by tapping the coil at about every 10 turns.



All components can be seen in this photograph. Of the types of fixed detectors available, the germa nium diode will give best results.

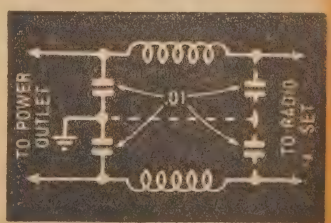
MAINS FILTER FOR RADIO

If you are troubled by electrical interference arriving at your set via the power mains, here is one way in which a reader went about minimising it.

THE chokes are made up by winding about 100 turns of 22 to 24 SWG wire (either enamelled, DSC or DCC) on a 2in cardboard former. Mount both chokes in any suitable fashion inside a metal box, such as with wooden clamps or insulating stand-offs, so that they are quite clear from the inside of the box. There must be no risk of a short-circuit to the box.

Connect one end of each choke via a 3-core power flex running through a rubber-grommeted hole in the box to the power outlet. The green wire of this flex should connect to the metal case and to the "earth" pin of the 3-pin plug at the other end. Connect two .01 mfd mica capacitors, one from each choke to the metal case.

The other ends of the chokes are connected to the appropriate pins of a standard 3-pin power socket mounted on the box. It will be a matter for experiment whether a similar pair of capacitors are required at this end of the chokes.



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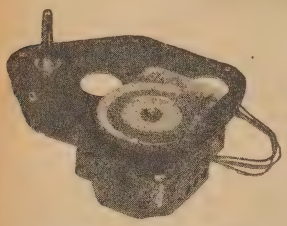

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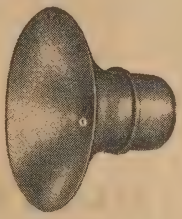

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TRADE REVIEWS AND RELEASES

BOOK REVIEW

MAGNETIC RECORDING

MAGNETIC RECORDINGS, by S. BEGUN (Chief Engineer of the rush Development Co.). Hard cloth over, 242 pages, published by Murray Hill Books Inc. Australian rice 55/- (approx.), plus postage.

For those anxious to make a close udy of magnetic recordings, this ook by Begun could well fill the ole of a basic text. It combines athematical and graphical analysis, most useful fashion, with a prac- cal approach and discusses the types f equipment available in the field t present.

The first two chapters deal with e history and basic requirements f recording and are purely general character. Chapters 3 and 4 examine e theory of magnetic recording nd playback, taking in the effect f bias, limitations of linearity and equency response, the design of mponents and a great deal of other formation.

Chapters 5 and 6 are of considerable ractical value, being devoted to il- strations and descriptions of re- rding mediums and components, gether with complete recorders, oth tape and wire.

The book concludes with special ections on the applications of mag- tic recording and instruments ecessary to examine and measure erformance. The author's sum- ary comparing tape and disc re- rding as a medium for home stening also makes interesting eading.

Altogether it is an excellent book r the serious student.

MAGNETIC BIAS COIL FROM Q-PLUS

Latest product from Messrs. R. W. Steane—a bias oscillator coil—will be of particular interest to intending constructors of magnetic recording equipment.

DESIGNATED as type O.M.E., the coil is in a standard 2¼ x 1-3/8 inch round can and is provided with a slug for inductance and frequency adjustment. When tuned with a .004 mfd. condenser, a frequency range of about 30-50 Kc. is available, according to requirement.

The coil is normally intended for use with a 6V6 or a 6AQ5 power valve and a circuit enclosed with the coil suggests suitable component values.

It is basically intended for use in a Hartley circuit and the erase or bias voltage may be derived from the plate end of the coil through a small condenser. A secondary winding is provided, however, for low impedance output, should this be required.

ELEMENTS OF SINGLE AND DUAL TRACK MAGNETIC TAPE RECORDING, by A. C. Shaney (Chief Engineer, Amplifier Corp. of America). Paper cover, 127 pages. Australian price 17/6 (approx.), plus postage.

Forming essentially a re-write of an earlier work, this latest book by Shaney is right up to date and very helpful. In the presentation, the author avoids mathematics and relies on illustrations and simple graphs to explain the mechanism of tape recording and playback.

An average radio enthusiast should have no difficulty in following the discussion from cover to cover.

As the title suggests, the text is concerned mainly with tape recording, reference to wire and disc being more for purposes of contrast than anything else.

The discussion begins logically with the history and advantages of tape recording, then passes step by step through the processes of recording, playback, and erase. A review of tape handling techniques follows next, leading to a discussion of the dual-track principle.

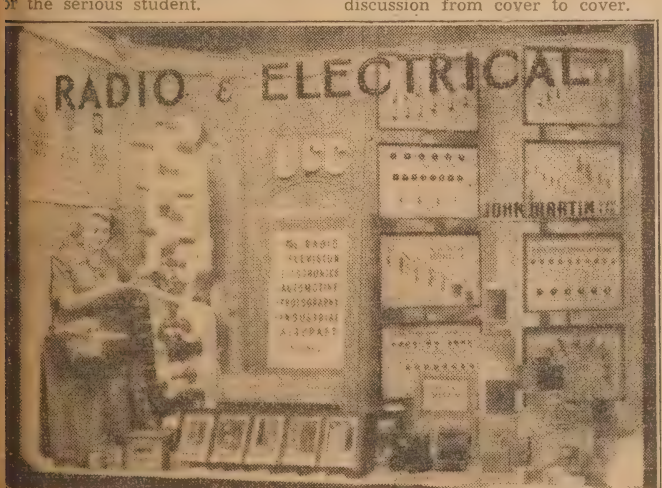
The remaining chapters in the book cover magnetic recording accessories, performance data, possible applications and, finally, tape as a medium for the record collector. The book represents particularly good value for the money. (Our copy from Angus & Robertson.)

MAGNETIC TAPE RECORDING, by P. A. Tarry, A.M.Br.I.R.E. (Fourth Edition). Paper cover, 70 pages published by Audigraph Pty. Ltd. Birmingham. Australian price 12/3 (approx.), plus postage.

Written by a British author, this book provides a handy, easy-to-read summary of magnetic tape recording. No space is spent over history or preamble, the style being to present facts and figures in a concise fashion and under easily-followed chapter and subject headings.

Thus under "SPOOLS" is found necessary information on types and diameters while, under "TAPE SPEEDS" is given necessary information and tables. This treatment culminates in typical circuit arrangements and such like at the end of the book.

The work can be recommended for anyone who wants to pick up the elements of the subject in a couple of evenings study. (Our copy from Angus & Robertson.)



This attractive display at John Martin Pty. Ltd., of Clarence St., Sydney, featured the current range of UCC capacitors. They ranged in size from tiny radio components to large industrial units.

LIGHT—AND THE EYE OF A CAMERA

There is little doubt that a photographer's most valuable single piece of equipment is his lens, and this article is designed to tell you something of how it works, and explain some of the mysterious figures often quoted about it.

IN order that we may get some idea of just how a lens works, it is necessary first to consider some of the simple laws of light.

Light is usually thought of as travelling in a straight line and, in the main, this is true. Admittedly, there is some evidence of light rays being bent when they pass close to an object but this is a subject worthy of separate study and has little bearing on our discussion.

BENDING RAYS

However, there is another condition under which light rays are certainly bent and that is when they pass from a transparent medium of one density to that of a different density. Stated in more everyday terms we may say that light rays are bent when passed from air into water or from air into glass (or vice versa).

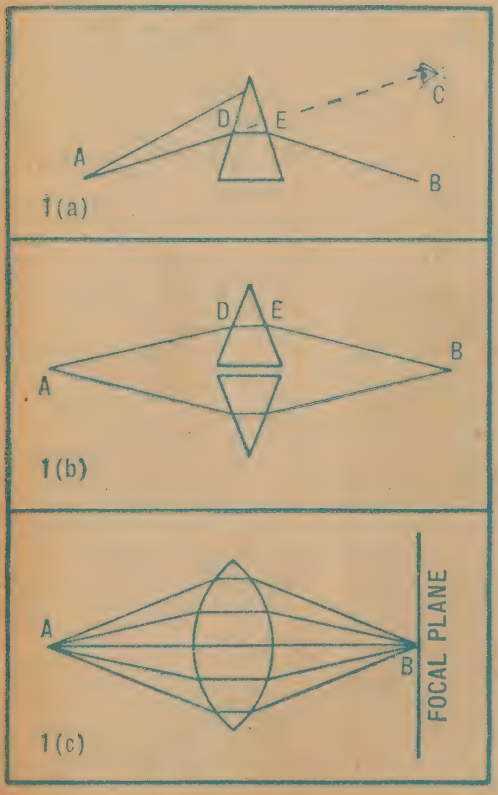
The air-to-water condition is one we have all observed at some time, when a stick entering the water at an angle has appeared bent below the surface, or when we have jumped into what looked like three feet of water and found we had to swim for it!

This ability to bend light rays is known as refraction and the exact amount by which a particular material will bend a ray is indicated by a figure called the refractive index.

In figure 1 (a) we see how refraction effects a single ray of light. Assume that this ray originates at point A and travels to point D where it strikes one surface of a triangular block of glass, called a prism. On entering the glass, the ray is bent so that it emerges at the point E, where it is again bent. Thus the original ray, which would have been observed at C without the intervention of the prism, is now bent to point B.

In figure 1 (b) we have two prisms base to base and the effect is repeated in the lower one, so that two rays of light originating at A are brought together again at B. From here it is but a step to considering all the rays from A which reach the prisms, being bent to point B. When this happens the point of light at A will be reproduced as a point of light at B.

If we now consider that all the points of light in front of the prism have been treated in the same way as the single point A, it will be appreciated how an image is formed on a plane passing through point B. This is known as the focal plane.



Showing how a simple prism will bend a ray of light. The ray which would normally be observed at "C" has been bent to "B".

Two prisms concentrate two rays of light from "A" to a point at "B".

A perfect lens will concentrate all the light rays from "A" to a point at "B". The simple type shown is far from perfect, and even the best have some defects.

SIMPLE LENS

While our two prisms serve very well to explain the bending of light rays, they could not be regarded as even a crude form of lens. Instead we must now consider the spherical surfaces which form the basis of most lens elements. In figure 1 (c) is shown a simple lens, and it is easy to see how this has been derived from the prism arrangement.

This simple lens has many drawbacks from a photographic point of view, but it will serve, for the time being, to explain the more important optical terms. So far, we have only considered that condition where the points of light to be reproduced have all been at the same distance from the lens. In this case they will all fall in the same focal plane, but when we have to reproduce points which are at varying distances, there arises a quite different set of conditions.

In figure 2 (a) is represented two extreme conditions. The solid lines represent rays of light coming from a point at infinite distance and are parallel. These will be bent so that they form a point of light at A, so that the focal plane must pass through this point to correctly reproduce all those points at infinite distance. (In practice all objects beyond about 200 feet may be regarded as being at "infinite" distance.)

EXTREME CONDITIONS

Now consider the case where the object (B) is only a few inches from the lens, and the rays are represented by the dotted lines. Here they come to a point at C, so that the focal plane will have to be moved to this position in order to reproduce a clear image.

But what happens to the light rays from the object at infinity? If we extend these (by dotted lines) from the old focal plane to the new one, it will be seen that what was a point of light now becomes a large circular patch, and as this happens to every point representing the object at infinity, it becomes impossible to produce a sharp image.

Thus we must conclude that the lens-to-focal-plane distance requires to be adjusted for every lens-to-object distance or, in other words, the lens has to be "focused" for each working distance. Also, it would appear impossible to focus simultaneously on two objects at different distances.

Strictly speaking, this is correct, but it will be shown that by accepting a standard of definition a little less than the theoretically perfect we can, in fact, achieve this condition.

Also shown in figure 2(a) is the meaning of "focal length," which is the distance between the lens and the focal plane when the lens is focused on an object at infinity. This must be regarded as a somewhat rough definition as the exact part of the lens from which the measurement is made must be determined by fairly complicated mathematical calculation. However, it is quite good enough for the amateur photographer.

SMALLER OPENING

So far we have considered those conditions where the full area of the lens is used, but there are a number of reasons why this is not always desirable. Figure 2(b) shows a metal plate located behind the lens and having in it a hole very much smaller than the lens diameter.

It will now be seen that of the parallel rays which strike the lens only those which pass through the centre section are used to form an image and when these are extended to the focal plane for a close object the circular patch of light is much smaller than was the case when all the lens was used.

If this idea can be carried far enough the patch of light can be made so small that it is indistinguishable from a point and when this happens objects at varying distances can be reproduced simultaneously with acceptable clarity, even though the theoretically clearest detail is still only obtained at the one distance.

NEW TERMS

This brings us to several new terms, such as "circle of confusion" (nothing to do with the Queens Square tram loop!), "depth of field" or "depth of focus," "stops" and "stopping down." The circle of confusion is the name given to the patch of light produced by the out-of-focus condition, while the depth of field is the distance through which an object may be moved before this circle becomes large enough to be distinguished from a point.

The "stop" is the device used to restrict the area of lens in use and "stopping down" is the process of decreasing this area. Thus by using a stop to stop down the lens we reduce the circle of confusion and increase the depth of field.

A more concrete example of this idea may help. Suppose that a lens at full aperture is focused accurately on an object at 10 feet and that it is found that all objects from about 8¾ feet to 12 feet are reasonably sharp. The lens is now stopped down to a smaller stop and we find that the same degree of acceptable sharpness extends from 8½ to 15 feet. It is usually possible to decrease the stop still further to a point where sharp images are obtained from a few feet to infinity.

The next point to be considered is the numerical value given to the size of the stop opening or the "f" number of a lens. This is simply the focal length of the lens divided by the diameter of the stop, so that a lens of 4½ inches focal length with a diameter of 1 inch will haxe a maximum f value of 4.5. However, when the stop is reduced to one half-inch diameter the effective value will be f9.

So far we have only considered stopping down as it affects the depth of field, but we must also consider its effect on the amount of light which is allowed to pass. As the stop is decreased in size the amount of light will also be decreased, so that the final setting is often a compromise between one that will pass a usable amount of light and one that will give the required depth of field. Where a considerable depth of field is required and a very small stop

DEPTH OF FIELD FOR 2" LENS

Distance In Feet	3	4	5	7	9	12	15	20	30	50	Inf.
f2.8	2'11"	3'9"	4'7"	6'3"	7'9"	9'10"	11'10"	14'9"	19'6"	26'4"	55'6"
	3'2"	4'4"	5'6"	8'0"	10'9"	15'4"	20'6"	31'3"	65'6"	500'0"	Inf.
f4	2'9"	3'7"	4'5"	6'0"	7'4"	9'4"	11'0"	13'6"	17'6"	22'9"	41'8"
	3'2"	4'5"	5'8"	8'5"	11'5"	16'10"	23'5"	38'4"	107'0"	Inf.	Inf.
f5.6	2'8"	3'6"	4'3"	5'8"	6'11"	8'6"	10'0"	12'0"	14'11"	18'8"	29'9"
	3'4"	4'7"	6'0"	9'2"	12'11"	20'1"	30'3"	61'0"	Inf.	Inf.	Inf.
f8	2'7"	3'4"	4'0"	5'3"	6'3"	7'7"	8'8"	10'2"	12'3"	14'9"	20'10"
	3'6"	4'11"	6'7"	10'6"	15'10"	28'4"	53'6"	500'0"	Inf.	Inf.	Inf.
f11	2'6"	3'2"	3'9"	4'9"	5'7"	6'7"	7'6"	8'7"	10'0"	11'7"	15'1"
	3'9"	5'5"	7'6"	13'1"	22'4"	58'9"	Inf.	Inf.	Inf.	Inf.	Inf.
f16	2'4"	2'10"	3'4"	4'2"	4'10"	5'7"	6'2"	6'10"	7'9"	8'7"	10'5"
	4'2"	6'6"	9'7"	21'4"	66'6"	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.

DEPTH OF FIELD FOR 3" LENS

Distance In Feet	3	4	5	7	9	12	15	20	30	50	Inf.
f4	2'10"	3'9"	4'7"	6'3"	7'10"	10'1"	12'1"	15'2"	20'3"	27'9"	62'6"
	3'1"	4'3"	5'5"	7'10"	10'6"	14'10"	19'8"	29'5"	57'9"	250'0"	Inf.
f5.6	2'9"	3'8"	4'6"	6'0"	7'6"	9'5"	11'2"	13'9"	17'11"	23'7"	44'7"
	3'2"	4'4"	5'7"	8'3"	11'3"	16'5"	22'7"	36'3"	91'8"	Inf.	Inf.
f8	2'8"	3'6"	4'3"	5'8"	7'0"	8'8"	10'1"	12'0"	15'3"	19'3"	31'3"
	3'3"	4'7"	5'11"	9'0"	12'7"	19'6"	28'10"	55'6"	750'0"	Inf.	Inf.
f11	2'7"	3'4"	4'1"	5'4"	6'5"	7'10"	9'0"	10'7"	12'11"	15'7"	22'9"
	3'5"	4'10"	6'5"	10'1"	14'10"	25'4"	44'0"	165'6"	Inf.	Inf.	Inf.
f16	2'6"	3'2"	3'9"	4'10"	5'8"	6'9"	7'7"	8'9"	10'3"	11'11"	15'7"
	3'8"	5'4"	7'4"	12'8"	21'3"	51'8"	375'0"	Inf.	Inf.	Inf.	Inf.
f22	2'4"	2'11"	3'5"	4'4"	5'0"	5'10"	6'5"	7'3"	8'3"	9'3"	11'5"
	4'4"	6'2"	8'10"	18'1"	42'6"	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.

DEPTH OF FIELD FOR 4½" LENS

Distance In Feet	4	5	7	9	12	15	20	30	50	Inf.
f5.6	3'9"	4'8"	6'4"	7'11"	10'2"	12'3"	15'8"	20'9"	28'8"	67'0"
	4'3"	5'5"	7'10"	10'5"	14'7"	19'4"	28'6"	54'4"	197'0"	Inf.
f8	3'8"	4'6"	6'1"	7'6"	9'6"	11'4"	14'0"	18'4"	24'3"	46'11"
	4'4"	5'7"	8'2"	11'1"	16'1"	22'1"	34'10"	83'4"	Inf.	Inf.
f11	3'7"	4'4"	5'9"	7'1"	8'10"	10'5"	12'7"	16'0"	20'4"	34'2"
	4'6"	5'10"	8'9"	12'2"	18'6"	26'9"	48'3"	246'0"	Inf.	Inf.
f16	3'5"	4'1"	5'4"	6'6"	7'11"	9'2"	10'10"	13'2"	16'0"	23'6"
	4'9"	6'4"	9'11"	14'7"	24'6"	41'6"	134'6"	Inf.	Inf.	Inf.
f22	3'2"	3'10"	4'11"	5'10"	7'0"	8'0"	9'2"	10'10"	12'9"	17'1"
	5'2"	7'1"	11'10"	19'0"	40'4"	123'0"	Inf.	Inf.	Inf.	Inf.
f32	2'11"	3'6"	4'4"	5'1"	5'11"	6'7"	7'5"	8'5"	9'6"	11'9"
	6'0"	8'8"	17'4"	38'6"	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.

DEPTH OF FIELD FOR 5½" LENS

Distance In Feet	5	7	9	12	15	20	30	50	100	Inf.
f5.6	4'8"	6'5"	8'1"	10'5"	12'8"	16'1"	22'0"	31'0"	45'0"	81'10"
	5'4"	7'8"	10'1"	14'1"	18'4"	26'6"	47'4"	128'8"	Inf.	Inf.
f8	4'7"	6'3"	7'9"	9'11"	11'11"	14'10"	19'9"	26'9"	36'6"	57'4"
	5'5"	8'0"	10'8"	15'2"	20'4"	30'9"	63'6"	391'0"	Inf.	Inf.
f11	4'5"	6'0"	7'5"	9'4"	11'0"	13'6"	17'5"	22'9"	29'5"	41'9"
	5'8"	8'5"	11'6"	16'10"	23'5"	38'6"	107'0"	Inf.	Inf.	Inf.
f16	4'3"	5'7"	6'10"	8'5"	9'10"	11'9"	14'8"	18'3"	22'3"	28'8"
	6'0"	9'2"	13'1"	20'8"	31'6"	66'3"	Inf.	Inf.	Inf.	Inf.
f22	4'0"	5'3"	6'3"	7'7"	8'9"	10'2"	12'3"	14'9"	17'3"	20'11"
	6'7"	10'6"	15'10"	28'4"	53'7"	500'0"	Inf.	Inf.	Inf.	Inf.
f32	3'8"	4'8"	5'6"	6'6"	7'4"	8'4"	9'8"	11'2"	12'6"	14'4"
	7'8"	13'8"	24'2"	73'9"	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.

This table has been compiled for the most popular focal lengths. It will not be difficult to estimate the performance for intermediate values.

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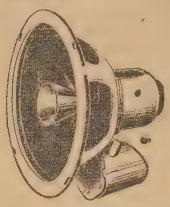

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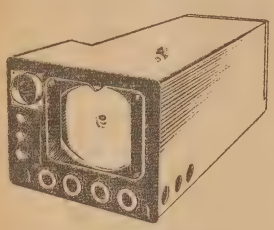

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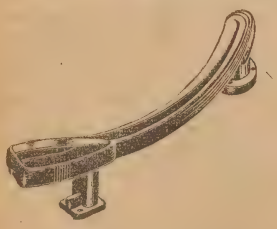

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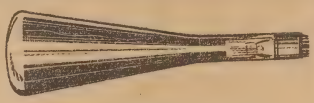

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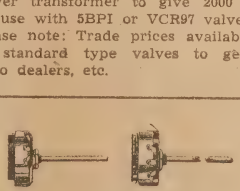

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nust be used, this can only be com-ensated for by a long exposure time.

The f values marked on a lens nount are so selected that a change rom one to the other either doubles r halves the exposure, depending on he direction, an increase in the f alue representing a decrease in the mount of light passed.

The most popular series of numbers n the English-speaking countries is 2, 2.7, 4, 5.6, 8, 11, 16, 22, &c., while 'ontinental countries adopt a series 'hich are all slightly smaller i.e., 2.2, 3.16, 4.5, 6.3, 9, 12.5, 18, 25.3, &c.

In each series a particular number 'ill give double the exposure of the ext highest number, but a certain mount of confusion arises when the wo systems are mixed, as often appens on both lenses and exposure uides.

Thus we find that a lens may be narked f3.5, 4, 5.6, 8, &c., where ne difference between f3.5 and f4 is onsiderably less than the normally ccepted value of one stop. This is sually caused by Continental lenses eing made with maximum apertures o suit their own numbering system, ut when they are to be exported ne stops are calibrated according to ne system of the importing country.

WO SYSTEMS

As long as these two systems are early recognised no confusion nould arise, but it is not unusual or beginners to imagine, for example, nat f6.3 will give twice the exposure f f8, whereas the real value is 5.6.

In the case of exposure guides and neters the confusion seems to have een caused simply by a desire to nake the unit appear comprehensive, ut has really only caused values like 5, 4.5, 6.3, &c., to be substituted or the correct values of 2.7, 4.5 or 6.

While the amount of light passed y lenses of different focal length is ssentially the same with equal stop umbers the depth of focus varies onsiderably, being greater in the ase of a short focal length than a ng one, all else being equal. This ncludes correct degrees of enlarge-ent to produce equal-sized images, o that two pictures identical in very way but taken with 7-inch and -inch lenses respectively will show ne greater depth of focus in that aken with the 3-inch.

In stating that a certain depth of ocus is obtained under certain con-itions it is obvious that some stan-ard must be set as to what is the cceptable maximum size of the circle f confusion. Furthermore, this must e the size in the final print, thus llowing for any enlargement, so nat some difficulty arises in com-aring lenses of different focal ngths unless it is known that the nal prints will be of the same size.

Although various standards have een set, the one which seems to be ost generally accepted is a circle of onfusion on the final print not ex-eeding .01 (one hundredth) of an nch diameter. This diameter is con-dered to be indistinguishable from point at a distance of 10 inches rom the eye, about the minimum dis-nce at which it can focus in com-ort.

In the past there has been con-

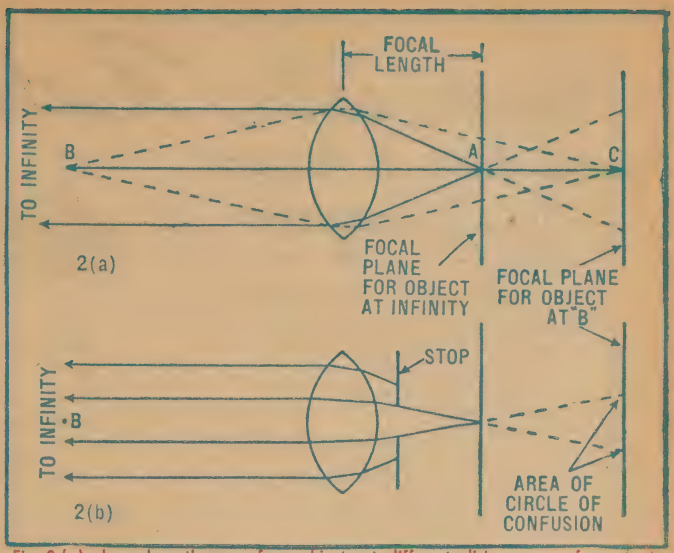

Fig. 2 (a) shows how the rays from objects at different distances are focused at different points, and how the circle of confusion results from an out-of-focus condition. Fig 2 (b) shows how a small stop reduces this circle.

siderable variation in published depth of focus tables, due to the circle of confusion being calculated for the negative so that short focal length lenses, which produce a small negative, appear to have a phenomenal depth of focus.

These errors are largely overcome when the circle of confusion on the negative is specified in relation to the focal length and a figure of .001 (one thousandth) of an inch per inch of focal length appears to be the most popular standard.

This means that a 10-inch lens will produce a circle of .01-inch on the negative, which will normally produce a satisfactory print by contact. On the other hand, a 2½-inch lens will require to produce a circle of .0025, so that when enlarged to the same size as the above contact it will also be .01.

It is possible to calculate the depth of focus for a given focal length, f value, and working distance, for the above, or other selected standard, but to save you from a mathematical nightmare we are publishing tables covering the four most popular lens sizes. A study of these will give you a clear idea of just how your lens

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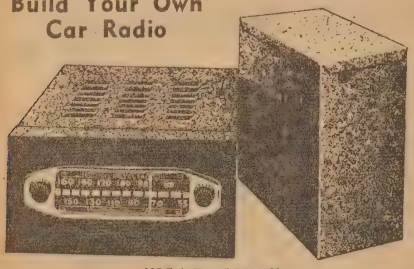

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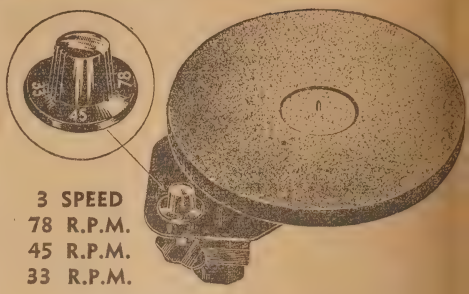

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l perform. They are calculated a circle of .01 on a print enlarged the correct degree for viewing 10 inches.

Another lens characteristic often erred to is the hyperfocal distance, ich is that distance to which the s may be set, for a given f value, that the depth of field extends m half that distance to infinity. is particularly valuable when con- erable depth is required, enabling fullest possible use to be made a particular stop without wasting depth "beyond infinity."

Fortunately this is quite a simple culation, and those who are inter- ed may make up a simple table their own use from the following mula:

H (in inches) equals 1000 x F ided by f, where F is the focal gth in inches and f is the stop mber.

For example, a 3-inch lens with a p of f11 will have a hyperfocal tance of 22.5ft, so that all objects m 11.25ft to infinity will be sharp.

LL-DISTANCE" LENS

By this time you have probably ncluded that depth of field is the planation of the so-called "all-dis- ice" lens fitted to a box camera and ich does not require focusing. This nclusion is quite correct, although ver standards than those quoted usually adopted, as the defects of s type of lens mask any attempt at igh degree of accuracy.

So far we have been discussing the mple form of lens and assuming t this is free from all defects, a ndition which, unfortunately, is ry far from true. If it were true e would not have to part over with ny pounds of hard-earned cash a good quality one.

The fact that it is a good deal more mplicated than the simple type ustrated does not have any bearing the terms or figures we have been scussing, which applies equally ll to all types of lenses and which ould help you considerably in get- ng the best possible results from ur own.

LITTLE GENERAL--1951

(Continued from Page 55)

binet to allow the dial glass to me up against the escutcheon hen the set is positioned in the binet. Simply mark the outline of cut-out sufficient to take the lamp d holder, carefully cut around and t out two layers of ply in the nch ply front.

The area of the cabinet inside ont allocated to the speaker should built up with a couple of layers corrugated cardboard, the type hich has the corrugations between o flat sheets. The packing can ex- nd from the inside edge of the dial ate over the remainder of the in- e front, with a cutout of about 4½ hes diameter for the speaker ne. Glueing or pinning will hold e packing in place. The beauty the corrugated cardboard as a cking is that, by making it a shade the full side, it will easily com- ess to the desired thickness when e set is pushed into place. What's ore, it's easy to cut and trim.

YOUR PERSONAL THERMOSTAT

(Continued from Page 13).

day. The stopcocks are turned off and the skin, deprived of the extra blood, ceases to act as a radiator.

If the human body were confined in a room the temperature of which is very much greater than the normal body temperature, the body temperature would not rise much above normal even though the room temperature were great enough to cook a beef steak.

Here nature has made use of the principle of evaporation to maintain body temperature.

It has been calculated that a drop of sweat when evaporated on the skin removes from the body as much heat as would boil two other drops.

The skin is permeated with sweat glands which open out to the surface and every square inch of skin is provided with about 500 of these glands. The palms of the hands and soles of the feet are much more amply provided.

SWEAT GLANDS

These sweat glands are controlled by centres in the brain and cord much the same as are the temperature transmitters and stopcocks.

When the blood supply to these nerve centres becomes warmer than usual the centres immediately send out impulses and the nerve cells send more impulses which stimulate the sweat glands into action.

If the surrounding air is dry and hot, evaporation takes place from the surface of the skin at an enormous rate and cooling is rapidly effected. A breeze on the skin surface also aids evaporation. That is why one can feel positively cold when soaked with perspiration on a hot day a breeze blows on the skin.

Those of us who are unfortunate enough to have a garden which must be dug like mad on a hot day in the limited time at one's disposal between races on a Saturday know what this sweat evaporation feels like.

When the blood returns to normal the processes of sweat gland stimulation ceases.

Excessive sweating causes thirst which in turn, stimulates sales in drink shops, soft and hard.

Men working in such places as the stokehold of a steamer can easily drink about 12 pints in two or three hours. Most of this is sweated out again and the temperature of the body is thus kept normal.

It may so happen that the temperature of the air is above body temperature and laden with moisture, so that evaporation cannot take place.

HUMIDITY

This happens sometimes in Australia's coastal cities.

In such an atmosphere, sweat cannot evaporate. The body also absorbs heat much more rapidly in a hot moisture-laden atmosphere.

Under such circumstances, the thermostat of the body may break down and the effect known as "heat stroke" occurs.

It is noteworthy that the tissues of the brain cease to operate when the temperature rises to 105 degrees Fahreinheit. Above that temperature it is impossible for the human being to live for too long as the brain cells and spinal cord cells will suffer destructive changes.

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ULTRA-SONIC JOINS IN ALUMINIUM

Although aluminium is probably one of the most useful metals in the radio industry, it has always suffered from the disadvantage of being rather difficult to join. Admittedly the established methods, such as brazing, oxy-acetylene, arc-resistance and spot welding are, up to a point, satisfactory, but all require the application of considerable heat and this is not always a good thing in certain kinds or work.

TWO new low-temperature methods have recently made their appearance in Britain—both, incidentally, coming from radio and electrical companies.

The first is cold pressure welding, developed by the Research Laboratories of the General Electric Company, for making homogeneous welds solely by pressure at room temperature. No flux is used, the tools are simple and inexpensive and no special machines are needed beyond those commonly found in industrial machine shops.

The process merely involves pressing the two pieces of aluminium together until they flow at the surfaces; then the molecules of the separate pieces come into such intimate contact that they run together and form a true weld.

Careful cleaning of the two surfaces is, of course, necessary to achieve this and scratch-brushing has been found the most suitable method. It is interesting to note, however, that there is no such thing as an indifferent weld caused by contamination: either the metal is perfectly clean and there is a perfect weld or it is dirty and there is no weld at all.

Soft-soldering of aluminium is the other new low-temperature method of jointing, and this has been made possible by the ultrasonic soldering iron developed by Mullard Electronic Products. Hitherto, the difficulty with soldering aluminium has always been the highly refractory film of oxide which forms so easily on the metal and prevents the solder from flowing.

FLUXES

Fluxes that react with the oxide have been tried, but are not very successful as the film re-forms immediately after the reaction has ceased. With the ultrasonic soldering iron, however, the oxide film is broken up by a 20-kc/s vibration coming from the soldering bit itself, after which the solder flows on to the metal in the usual way. The removal of oxide by this method is so effective that no flux is required at all.

The same principle can be applied to the tinning of aluminium by immersion, only here the ultrasonic power energises the bath of molten solder and, through this, attacks the oxide film as soon as the metal is dipped.

For generating the necessary ultrasonic power the soldering iron employs a magneto-striction transducer. This consists of a stack of iron-alloy laminations wound with two coils, one of which, the driving coil, is connected to the output of an amplifier, whilst the other, the pick-up coil, is connected to its input.

Thus a feedback loop is formed with the soldering iron as an integral part of it, and oscillations at the natural frequency of the magneto-striction element are maintained by the gain of the amplifier.

Ultrasonic vibrations generated in this way are then conducted by a solid bar to the soldering bit, which is made of nickel silver and is heated by a resistance-wire element in the usual way.

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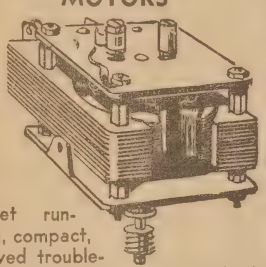

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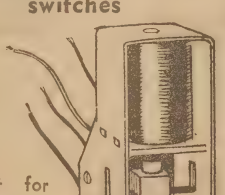

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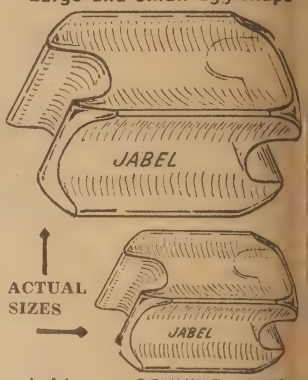

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THE SERVICEMAN WHO TELLS

(Continued from Page 59)

oses the circuit to either the upper lower half of the transformer, the ain will be increased. In other ords, the current drain will vary the vibrator contacts open and ose, which in turn will vary the oltage drop across the lead resist- ce and the voltage applied to the lament network.

It is usual to provide a large apacitance electrolytic, about 500 fd, across the filament circuit, plus iron-cored choke in series, to ep voltage variations to a mini- um. However, there is a limit to e amount of filtering which this ill effect. Thus, as the lead resis- nce increases, so does the voltage ariation of the filament network.

RID HUM

It might at first be thought that nsiderable filament temperature ariation, and consequently a large oltage variation, would be necessary cause any appreciable hum but it ust be realised that the filament rcuit is also the biasing system and at these variations are really ap- ied to the grid circuits. Obviously, does not take much ripple voltage the grid of the audio valve to pro- ce a substantial hum in the out- t.

I had another case this month with me rather unusual features. This me only the chassis was delivered the shop, and the owner com- ained that the magic eye had iled, putting the set out of action. e had tried to buy a new one, but was a continental type and not adily available. The set was a irly old one and he explained that had just bought a new one, but anted to keep the old one as a cond set—that is, if it could be paired at a moderate cost.

PEAKER PROBLEM

I explained that the failure of the e did not necessarily mean that e component itself had failed, but at it was more likely that a failure thin the set, probably the HT, had t both out of action.

I did not worry particularly about e speaker being missing, reason- g that the bench speaker would te care of things, but I did men- n to the owner that the trouble uld be in it and he promised to ing it in the next time he passed. On examining the set more closely realised that I had rather over- timated the range of my bench eaker, for the speaker socket was less than a seven pin, six of which re actually in use. In the normal urse of events I would have left e job until the speaker was avail- le but, being a little slack, I de- led to tackle it immediately.

The connections took a little work- g out but, by isolating those to the st and second electrolytics and the ate of the output valve, I was able get some idea of the purpose of e remainder.

It seemed that the plug contained safety link between the rectifier filament and the first electrolytic, thus protecting the latter if the speaker plug was removed. This accounted for four of the connections, and of the remaining two, one was earthed and the other found its way to a tapping on the volume control via a resistor network. I concluded that this was some form of voice-coil feedback.

Neglecting the feedback circuit, I made temporary soldered connections to the vital pins of the socket, and with a meter across the HT circuit, switched on. HT voltage appeared almost immediately, dropped back slowly as the valves warmed up and, as it settled at about 230 volts, the set began to play.

A check over the chassis showed no sign of loose connections and prolonged running gave no suggestion of intermittents. I therefore decided that it was probably an open circuit speaker transformer, made a mental note that I had a replacement in stock, and put it to one side until the correct speaker arrived.

NO HT!

When it did, I checked it for continuity and was surprised to find it OK. But as soon as it was plugged into the set the HT vanished, and a further continuity check showed that there was a short between the primary winding and the case of the transformer.

Well anyway, it still meant that the transformer had to be changed, so what did it matter?

When I came to change the thing I found out. It was not a voice coil feedback circuit, at least not in the usual sense, for it appeared to be picked up from a separate lead coming from the transformer. Just how this fitted into the scheme of things was difficult to say for, with a short already in evidence, there was no means of knowing whether continuity between this lead and the primary was right or wrong.

I thought of fitting a standard transformer and one of the more conventional feedback arrangements but this proved to be impracticable because the set had no audio stage, the signals from the diode going straight to the grid of a high gain output valve.

SPECIAL WINDING

Rather than waste more time over what was obviously a special design, I rang the service department of the manufacturer, where the mechanic informed me that this transformer had a special winding for the feedback circuit, but added that they had no replacement stocks and there was little hope of getting any.

"What do you do when you get one in for service?" I asked.

"Well," he said, "we've been lucky so far, we haven't had any."

I nearly retorted, "Well you're about to get one now, see what you can do with it."

However, I decided that this might be a costly procedure. Furthermore the owner was really only interested in making the set work and was not likely to worry unduly about the lack of feedback.

As a result of this reasoning, I settled for a standard transformer and no feedback and, while I am not keen on altering circuits if it can be avoided, in a case like this it seemed justified. Anyway the customer was quite happy when I explained the situation and, after all, that is the main thing!

ONE of the main causes of dust on motion picture films, which impairs the quality of the projected image, is the electrostatic charge caused by the film rubbing against certain substances, or when running over rollers in the projection mechanism.

Charge measuring devices have now been evolved which make it possible to determine the precise effect of various substances in creating or removing these charges. Best results so far appear to be obtained by rubbing the film with velvet soaked in carbon tetrachloride. This is only effective when applied to the support side of the film, and has little effect on the emulsion side.

LEARN WHILE YOU BUILD

(Continued from Page 31)

will be greatest at this frequency, so that while the wanted signals are being handled under almost "no loss" conditions, the unwanted ones are treated in much the same way as they would be without regeneration.

As you have probably guessed, it is essential that the reaction winding be connected the right way round, otherwise the feedback signals will oppose the incoming signals rather than aid them. With a commercial coil this is not usually a problem, as the correct pin connections are given but it sometimes causes bother with home-wound coils. However, it is usually quite easy to reverse the connections if correct operation is not obtained at the first attempt.

The arrangement used in this set is by no means the only method of obtaining feedback, nor is the variable condenser the only form of control. Various methods locate the reaction winding in the screen or cathode circuits, and control may be by varying either the plate or screen voltage of the valve.

Several of these schemes were tried on the present set, but the one finally chosen proved to be the best. This is not to say that those tried are of no use. In some respects they are to be preferred, but the combination of a high-gain valve, and a commercial coil having a predetermined amount of feedback coupling, made it difficult to provide smooth control when the valve was working at maximum efficiency.

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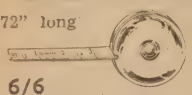

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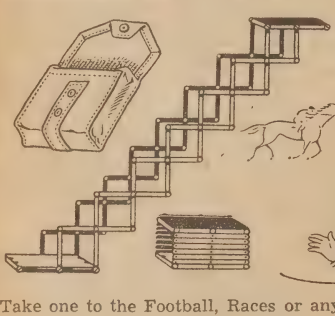

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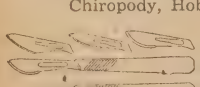

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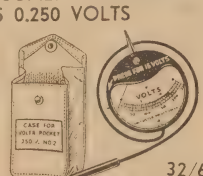

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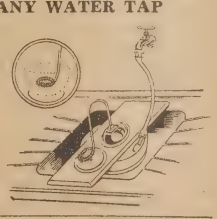

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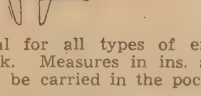

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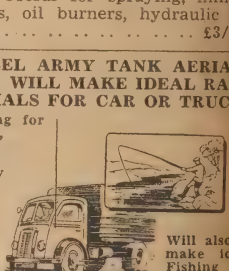

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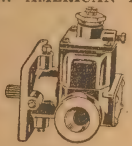

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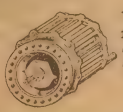

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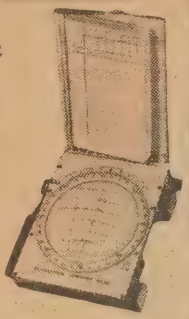

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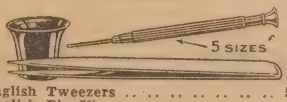

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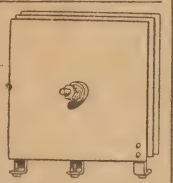

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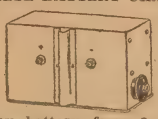

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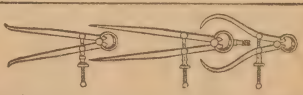

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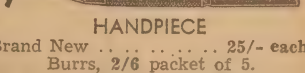

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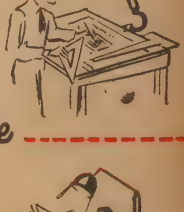

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TRANSMITTER ON 576 MEGACYCLES

(Continued from Page 67)

Up to 10 or 12ft from the radiator, 0-5 mA meter will give a good de-ction, although a 0-1 mA meter, or e even more sensitive, is best at eater distances. Do not bring the t dipole close to the radiator, other-se the high current may damage e meter or the diode.

Our dipole was cut from a wire 9 3in long but in the centre and unted on a two-terminal mount-g strip screwed to a piece of board g enough to protect the dipole m damage. It can be mounted on a ht stand made of a wooden foot d 3ft of ¾in dowel. The meter ds can be extended almost inde-itely.

ERIALS

Aerials for this band are a subject their own. Their small size allows kinds of beams to be made up and amined with the test dipole. Our periments were carried out with three-element beam illustrated, nsisting of a three-element folded ole made by bending a length of 3in tube 18¾in long, with a 3-16in acing. A third section was then dered across the ends, with the ne spacing. As the impedance at centre of such an array using a gle dipole is about 30 ohms, and a p-up of nine times results from the ee elements, this means that a od match is obtained to a length of ohm ribbon.

The reflector was 10in of the same bing, and the director 9 1-8in long. e parasitic elements are spaced n from the radiator.

With about 250 plate volts applied, second three-element beam using single slightly-lengthened dipole ached to a panel lamp in the cen-produced a glow several feet from radiating aerial. Many experi-nts can be carried out by adding d subtracting elements to and from rious beams and noting the rise and l of radiation which results — a cinating game which will occupy u for hours!

ODULATION

This oscillator can be modulated by single 6V6 with the same 250 volts plied through a small filter choke ed as the modulating choke. A rbon microphone feeding the 6V6 rough a suitable transformer will e enough output for a good signal. The grid meter is preferred to a ate meter because there will be very le change in plate current when the illator is loaded. The grid cur-nt is a much better indication of eration, and plate current need ly be checked to see that it is not cessive. Actual bias requirements y vary somewhat, and a bias re-tor of 2000 ohms should be the vest used. Even more than 3000 ms may be used, although 5000 ms may be about the highest value thout seriously reducing output. e RL18 is a robust valve, and is en abused, but it should not be ed on its full ratings until all justments have been made and a suitable load applied. The grid current should not be run higher than ratings except for very short periods.

Many amateurs use the valve with 300 volts without unduly reducing its life, and with much better output. Some even go higher than this. The makers wouldn't like it, and we think 300 volts the absolute limit of abuse, with 250 volts a reasonable overload. But grid current shouldn't be exceeded by any appreciable amount.

Many amateurs obtain results by grossly overmodulating the oscillator. Apart from the broad signal, this is hard on the valves, as it pushes up the plate dissipation. If you go for high output by exceeding ratings, be prepared to find valve life short, or to experience failures. It's a penalty to be paid in the absence of larger valves.

All coupling lines have high losses at 576 Mc, although the 300 ohm ribbon seems to have the least. Open wire line would be best for long runs. However, even 72 ohm twin-lead will still produce satisfactory output if not too long. Co-ax of good quality is good, but must be used with a balanced-to-unbalanced transformer if matching and balance are to be preserved.

The three element beam shown here is intended mainly for experiment. For communication over any distance, particularly where direct line of sight is not possible, a stacked array would be much better, not so much for a possible higher gain, but because of its greater area or aperture, and its ability to intercept more signal. This is a point not always realised with VHF arrays.

A good beam is an 8-element array backed by reflectors or a mesh made of flywire. This can be easily fed with 300 ohm line, and isn't too large to be simply mounted.

Feedlines are another problem, as the spacing of even a 300 ohm line is great enough to allow appreciable radiation loss. We may have more to say about aerials and feedlines in later issues.

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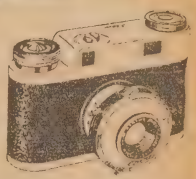

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REFLEKTA II: Twin-lens reflex focussing camera that shows you the entire picture before you actually take it! Synchronised matched and coated F 3.5 Meritar lenses for easy, rapid focussing. Ground-glass view-finder shows actual size picture. Takes standard 120 size roll film. With Prontor-S shutter 1 sec. to 1/300 sec. Deposit £5/10/- or Cash £27/10/-.

ILOCA II: A sensational 35mm. camera with coupled rangefinder, F 3.5 coated lens with Prontor-S Shutter, speeds 1 to 1/300 sec. T. & B. Flash contacts. Cable release fitting. Delayed action. Deposit £6 or Cash £29/10/-.

ILOCA 1B: Another precision Iloca! With F 3.5 lens, 8 speed Prontor-S shutter with speeds from 1 sec. to 1/300, Time and Flash synchronised. Deposit £4 or Cash £19/10/-.

ILOCA 1A: With Vario shutter, speeds 1/25 sec. to 1/200 Bulb and Flash contacts 35mm. film. Deposit £3 or Cash £13/19/6.

FINETTA: Flash Outfit! Black and white or colour film. Finetta camera has F 4 anastigmat interchangeable lenses, 3 speed shutter. Flash synchronised. Finelux Flash gun takes standard bulbs, folds away to put in your pocket and fits all cameras.

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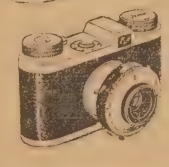

Finetta: Flash Outfit as given away by Bob Dyer on "Pick-a-Box"!

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SHORT WAVE NOTES BY RAY SIMPSON

As from the 1st June, all Australian high frequency stations adopted new call signs. Actually this consisted of new suffixes to follow the transmitter call sign, the particular numeral used indicating the megacycle band in use.

THE same suffix will be used for any frequency in that band, eg:
VLA9 any frequency in the 9 mc band.
VLB11 any frequency in the 11 mc band.
VLC21 any frequency in the 21 mc band.
As readers will see, this will have the effect of cutting down the number of call letters previously in use, and when you know the call letters being used it will be much easier to find the station as you will know which band to tune to.

This new method of indicating the call will be used by VLA, VLB, VLC, VLG, VLH, VLI, VLM, VLQ, VLR, VLW and VLX, and in addition by the Port Moresby station VLT.

As there have been some changes in frequency for the inland short wave services we are giving the new schedule showing new call letters and frequencies. All times quoted are local time where the transmitter is located.

NEW AUSTRALIAN SW SCHEDULE

Location	Mon. to Fri.	Saturday	Sunday	Call Sign	Freq.	W/L
Lyndhurst	0600-0815	0600-0815	0645-0815	VLR6	6150	48.78
	0830-1830	0830-1830	0830-1830	VLR9	9680	30.99
	1830-2300	1830-2300	1820-2300	VLR6	6150	58.78
	0600-0915	0600-0915	0645-0915	VLH11	11880	25.25
	0930-1815	0930-1815	0930-1815	VLH15	15230	19.70
	1830-2330	1830-2400	1830-2330	VLH9	9680	30.99
Sydney	0600-0845	0600-0845	0645-0830	VLI6	6090	49.36
	0900-1700	0900-1700	0845-1700	VLI9	9540	31.45
	1715-2330	1715-2400	1715-2330	VLI6	6090	49.36
Brisbane	0600-2330	0600-2400	0645-2330	VLQ9	9660	31.06
	0600-2330	0600-2400	0645-2330	VLM4	4917.5	61.01
Perth	0600-1015	0600-1015	0645-1015	VLW9	9610	31.22
	1030-1800	1030-1800	1030-1830	VLW11	11830	25.36
	1815-2330	1815-2400	1845-2330	VLW9	9610	31.22
	0600-1015	0600-1015	0645-1015	VLX4	4897.5	61.26
	1030-1800	1030-1800	1030-1830	VLX9	9610	31.22
	1815-2330	1815-2400	1845-2330	VLX4	4897.5	61.26
Port Moresby	0645-0845	0645-0830	0745-1100	VLT7	7280	41.21
	1200-1345	1200-1800	1200-1400	VLT9	9520	31.51
	1600-1800	-	1600-1800	VLT9	9520	31.51
	1815-2245	1815-2300	1815-2200	VLT7	7280	41.21

TWO LATIN AMERICAN VERIFICATIONS

YSN EL SALVADOR: Quite an attractive card was recently received from YSN Lo Voz de la Democracia, which is located in San Salvador, El Salvador, and operated on 7.315 mc. Their card is printed in green and black and at the top gives details of their stations YSO on 870 kc and YSN, which they list as being on 7.27 mc but which actually used 7.315 mc.

Alongside this information is a microphone with call letters on top. On the reverse side of card is a globe together with further information about the station. The card was signed by the station manager, Mr. Ed Nusen. I believe this station has now discontinued their short wave transmissions and now uses only YSO.

YNWA NICARAGUA: Here is another Latin American station which does verify listeners' reports and sends out a very attractive card printed in red, white and blue. This station is known as Radio Mundial and is located in Managua and operated on 6.46 mc, but has more recently been on 6.04 mc. Across the top of the card is the slogan Primera Cadena Nacional de Radiodifusion, and at the bottom Una Voz Desde Nicaragua para el Mundo.

They also make mention of their broadcast band outlet, YNW, which operates on 930 kc and uses 1000 watts similarly to YNWA. The card was signed by the station manager, but his name could not be deciphered.

STATION ADDRESSES

OVIEDO—Radio Falange de Oviedo, Asturias 15, Oviedo, Spain.
VALENCIA—Radio Alerta, Plaza de Tetuan 3, Valencia, Spain.
BUCHAREST — Societatea Romana de Radioifuziune, Bucuresti II, Strada A. St. Popov No. 41, Rumania.
CANDIA—Mr. Minos Tsangarakis, Radio Herakleion, Herakleion, Crete.
HONOLULU—Armed Forces Radio Services, APA 500, San Francisco, Cal., USA.
DZ12—Bolinae Electronics Corporation, San Juan, Rizal, Philippines.

SHORT WAVE NOTES for the August issue are due July 7. For the September issue they are due on August 11. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, NSW.

COBH—Radio Cadena Habana, Edificio O. Aliades, San Jose y Belascoain, Habana, Cuba.
COCX—Talleres Tipograficos Nacionales SA, La Emisora del Pueblo, Guanabacoa, Habana, Cuba.
HI3C—La Voz del Papagayo, Bella Vista 49, La Romana, Dominican Republic.
HI2L—La Vox del Tropico, Apartado 335, Ciudad Trujullo, Dominican Republic.
TGTA—Radio Bolivar, Avenida Bolivar 13-201, Guatemala City, Guatemala.

NEW STATIONS OF THE MONTH

Call	Kc	Metres	Location	Time Heard
PARIS	7160	41.90	Paris, France	5.30 am
MANDALAY	7410	40.48	Mandalay, Burma	9.30 pm
VLI9	9540	31.45	Sydney, NSW	9.00 am
VLR9	9680	30.99	Lyndhurst, Vic.	8.30 am
VLH9	9680	30.99	Lyndhurst, Vic.	6.30 pm
OLR4C	11875	25.26	Prague, Czechoslovakia	7.00 am
OZH	15180	19.76	Copenhagen, Denmark	8.00 pm
VLC15	15320	19.59	Lyndhurst Vic.	6.30 am

FLASHES FROM EVERYWHERE

GERMANY: Some of our New Australian listeners may be interested in th schedule of Leipzig which operates o 9.73 mc. They come on the air at 1.57 pm and continue until 6.12 pm. They ope again at 8 pm and continue right throug until 9.10 am the following day. News i German is given at 2 pm, 3 pm, 4 pm 8 pm, midnight, 4.30 am, 7 am and 9 am Their music consists of classical and als the well-known folk type. The best tim to hear this station in Eastern Australi is around 4 pm when it can be heard quite good strength. They are intereste in listeners' reports and verify all thos which are correct. Address is Mittel deutscher Rundfunk, Springerstrasse 2 Leipzig, N22, Germany.

NEW ZEALAND: There have been som changes in frequencies from Radio Ne Zealand and their short wave stations ar now operating as per the followin schedule:
4 am to 6.45 am ZL2 9.54 mc to Australia
4 am to 6.45 am ZL8 9.62 mc to Pacifi islands.
7 am to 4.45 pm ZL10 15.22 mc to Australia
7 am to 4.45 pm ZLA4 15.28 mc to Pacifi islands.
5.00 to close ZL2 9.54 mc to Australia.
5.00 to close ZL8 9.62 mc to Pacific island
On weekdays these stations close 8.45 pm and on Saturday their schedul is extended until 9.20 pm. On Sunda they leave the air at 8 pm.

ENGLAND: The British Broadcastin Corporation have just announced som changes in the General Overseas Servic in the interest of the needs of nationa economy. The changes have been mad so as to cause as little inconvenience t listeners as possible, and all the main pro gram features have been retained.

The round-the-clock programs of th GOS retain their familiar pattern, bu there will be no transmission during th hours 0800 to 1000 GMT and 0300 to 040 GMT (6 pm to 8 pm EAST and 1 pm t 2 pm EAST). These changes came int effect during the first week in June. Ther have also been some changes in th Special Services programs but these ar not very extensive.

USSR: Moscow now seems to have ex tended their transmissions in English an can be heard at quite good strength in th late afternoon and early evening on quit a number of frequencies in the 19 and 3 metre band. Most of these transmissio consist of news bulletins and news com mentaries, though on occasions there ar a number of musical recordings.

There is also a mailbag program whe letters from listeners are acknowledge Whether one agrees or not with the pol tical views expressed from Moscow must be admitted that they make fu use of short wave radio programs to fu ther their particular outlook on worl affairs and their approach to the al important question of peace.

MISCELLANEOUS: Recent reports in dicate that the Forces broadcasting statio at Malta has closed down and the statio in course of being moved to Fayid, Egypt. Art Cushen reports a new Indo nesian station heard around 8.30 pm oper ating on 7.17 mc. The same writer repor that there is a new outlet for the Taiwa station on 7.36 mc heard around 10 pm Radio Nederland has been heard testin around 5.30 pm on 9.59 mc with program for Australasia.

Overseas listeners report that Omdu man, in the Sudan, has been heard oper ating on 18.025 mc around 5 am, but w have not heard it at our location. Radi Australia advises that Ponta Delgado now using CSA92 on 11.09 mc from 6 a to 7 am and their other outlet on 4.845 m from 8 am to 10 am. The first one ca be heard very well. The same source tel us that the Kingston, Jamaica, statio which formerly used the call letters ZC has now dropped this call sign in favor the slogan Radio Jamaica. It is on th air from 9.30 pm till midnight on 4.95 m and again from 7 am till 2 pm on 3.36 m

THE HAM BANDS WITH BILL MOORE

QSL cards are insignia of amateur radio stations. Approximately 1½ million are exchanged each year between the amateurs of the world. They are sent to confirm communication between stations.

would seem that our age-old habit of xchanging QSL cards for all new con- ts made is falling into disregard. V2SN, QSL officer for the W2 district, orts that the number of cards handled him during 1950—91,000 in all—is 15,000 er than in 1949. Ray Jones, VK3RJ, stralian Federal QSL officer, in his nual report shows a fall from 71,868 ndled in the peak year 1947-48 to 45,466 950-51. Ray mentions there are several tors here affecting the drop, such as direct handling of cards by State L officers. He also points out that the r DX conditions during the year—the rst in history—must be a contributing tor.

V6WWW presents some interesting in- mation on the QSL business. He has cked his QSL percentage return from 7 to date. They are as under: China, in, Panama, Italy and Sweden pro- ced 100 per cent returns. France, echoslovakia, Belgium, South Africa i American possessions from 80 per t to 30 per cent. With 30 per cent to o returns are Cuba, Germany, England, ska, the USSR, Australia and New and. Perhaps that is not a true pic- e of things generally, but still it is no rertisement for the ZLs and VKs. If u say you will not QSL no one can nplain, but too many of us make a mise never to be fulfilled.

S DEFENCE

rganisation in amateur civil defence mmunications is proceeding apace in US. Several manufacturers are pro- cing special transmitting and receiving ipment to cover CD irequencies and ditions. One firm has marketed a com- te line of mobile and fixed station gear ering the CD bands from 80 metres vnwards.

uite a number of amateur nets are ng equipped with this commercial bile apparatus with the great advan- e that all units are interchangeable. he ARRL, after consulting the appro- ate authorities, issued a tentative plan- g guide to all their emergency co- linators and it is anticipated that the service will be known as The Radio nateur Civil Emergency Service. pecial recommendations have been de in the plan and they are briefly as lows:

mergency co-ordinators will be respon- le for all contact with public safety and il defence authorities.

ll licensed amateurs willing to be ned up for CD work will register with EC.

mateur units in all cities and areas l operate with the responsible local horities.

mphasis to be placed on portable and bile operation on the 28, 50, 144 and 220 bands.

ll unstabilised equipment can only be erated on the high end of the 144 Mc nd and in the 220-225 Mc allocation. eat emphasis is placed on this feature, the haphazard use of unstable trans- tters and radiating receivers could ily wreck the whole communications n.

Net frequencies within the allocated nds should be selected and crystals ound, and such frequencies should ow sufficient clearance between them any swamping by loud signals. hey finally suggest that nearby towns uld use a common frequency to allow exchange of equipment should the cessity arise.

X AND PERSONAL

is with deep regret we record the assing of another oldtimer, Frank Tar- t, VK2UF, of Cook's Hill, Newcastle, y 7.

Licensed in 1933, he was very active on all bands and taught a number of amateurs, including VK2MT, the Morse code.

Frank was active postwar on the 144 and 56 Mc bands, had been in ill-health for some time. A member of the Hunter branch, John Clark, VK2DZ, represented the branch at the funeral.

FI3AG turned up from Indo-China on few evenings, but it is anticipated that like F8ZZ he is a pirate—amateur radio operation is banned in that country.

A considerable number of South Americans is appearing most evenings on 7 Mc around 1930 hours. Never at great strength, they can be found beneath the usual collection of commercials and others around 7000 Kc. They generally give good signal reports—HK, OA, HC, CE are prefixes contacted.

QSL PROBLEM!

FP7XA and XB solved the financial aspect of the QSL business for their recent amateur radio expedition to Guadeloupe. Airmail QSLs were forwarded on the receipt of one dollar. Some of the VK gang have already received their cards, their W friends producing the necessary dollar. The card is quite an attractive one and shows CM7AA and his wife operating the station.

There seems to be a slight improvement in conditions on the 14 and 28 Mc bands.

During the afternoons 14 Mc has been opening to Europe for a couple of hours, while the South Africans on 28 Mc have been at excellent strength around 1700 hours EAST.

Of interest following on the new regulations in the US is the request to the Radio Society of Great Britain that they ask the GPO to introduce a novice class licence, as has been done in USA. The council of the RSGB resolved to take no action and to advise the inquirer that it considers the amateur bands are already congested.

The conditions during the weekend of the RSGB national field day were extremely poor. G6CJ had previously requested that Australian amateurs should look out for the 5-watt G stations, that power being the maximum allowable during the contest.

No G portable stations were heard during the morning peak on 14 Mc and GW3FRB was the only one heard during the afternoon, running about S2. He was in contact with ZL1MP, who told him he was the only field day station heard there also. Quite a number of VKs and ZLs were standing by ready to provide a few points.

FLOOD ALERT

Amateurs on the North Coast were alerted by Crieff Rettalick, VK2XO, of Raleigh, during the first week in June when areas were threatened by floods. Fortunately the weather cleared rapidly and river levels dropped.

The rules of this year's DX contest, the VK/ZL 1951 Jubilee DX Contest, have been changed from those decided upon at the Federal convention by a vote of the Federal council.

They will correspond closely to those of the ARRL DX contest rather than those of the BERU test. It means that the final score will be calculated by multiplying a fixed number of points per contact and countries worked rather than the descending scoring 15, 14, 13, &c., points per contact with each country.

It is considered that the simplifying of scoring will assist foreign amateurs.

The ZLs really enjoyed their first day on 7 Mc telephony. From midnight June 10 the band was open to them and telephony was permitted between 7051 and 7200 Kc. It is the first occasion that New Zealanders have been allowed this facility. We in Australia will certainly notice the influx of NZ stations on 7 Mc at certain times of the day, and at least they will be able to repay some of the QRM VK stations have caused them in the past.

From midnight the following day, June 10, a portion of the 160-metre band has also been returned for use by New Zealand stations.

OVERSEAS COMMENT

SOME months ago, as mentioned in this column, amateur radio received some adverse comment in the daily Press on interference with military channels in use in Korea.

The story, incidentally, made the headlines in newspapers all over the world.

As a result of an investigation by the US Army Signal Section it was found that the station in question was operating in the amateur bands.

It was recorded that the Army tanks use channels adjacent to amateur bands and on this occasion the tank had strayed from its normal frequency into the amateur allocations. Several American newspapers corrected the mistake and gave added publicity to the value of the amateur service.

The ARRL announces a new country for their DXCC—Saarland, with the prefix 9S4. They also have deleted credit for 3A1A, reputedly in Monaco, and PX1A, supposedly in Andorra, conclusive proof having been received that the first station did not operate from Monaco and, in fact, PX1A was located in Mexico. Both stations sent QSL cards showing their locations as per prefix.

The ARRL is still endeavoring to obtain justice for oldtimers under the new US regulations. They have submitted a petition for re-argument on the loss of status of the class A licence holders if any special privileges are granted to extra class licensees.

They will point out that it is not normal practice in any other field to re-examine members once they have qualified nor to take away privileges granted.

THE UHF BANDS

DURING late May Harry Hawkins, VK2YL, of Cessnock, heard signals during the afternoon on 144 mc that he believed emanated from the United States. He copied call-signs and has written away airmail for confirmation. During the particular day W stations on the west coast broke through to Hawaii on the 144 mc band to set up new records.

Harry is making no claims on the subject but is awaiting further news.

Ken Mitchellhill, VK2ANU, of Muswellbrook, and Con Bischoff, VK2LZ, of Wentworth Falls, chalked up a nice contact on 144 mc June 6 over a path of 104 miles. With both stations running low power signals were S7. Ken has also heard Bill Macgowan, VK2MQ, of Sydney, on this band, the distance 110 miles.

In memory of Bill Cottrell, VK2ZN, an enthusiastic UHF operator who passed away in December, the NSW division's UHF section will conduct an annual UHF contest. The winner will hold for a year the Bill Cottrell Memorial Trophy and retain a replica.

WIA NEWS

THE council of the NSW division for 1951-52 elected at their inaugural meeting the following officers for the year:

President of the division is Wal Nye, VK2XU, a past secretary and well known for his work in disposal affairs. Wal has the best wishes of all amateurs in his new position. John Moyle, VK2JU, was elected vice-president, and the second vice-president is well-known DX man Dave Duff, VK2EO. Dave also holds his

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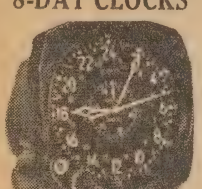

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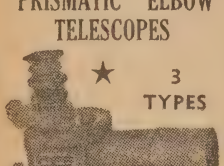

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TR9D. TRANSCEIVERS. Frequency range 4.3 to 6.6 mc/s, complete with two meters and the following nine valves—1-VT50, 2-VT51, 2-VR18, 1-VR27, 2-VR21, 1-VR22. A snap for the amateur radio man. **PRICE £4/10/-.**

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TELEPHONE GENERATORS. An A.C. Generator complete with handle and four screw fixing base. Change over shaft-actuated contacts for bell ringing, shocking, etc., suitable for converting buzzer type phones to bell alarm. **PRICE £1/17/6.** Postage 3/-.

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JONES PLUGS. We have imported a quantity of Jones Plugs and can now supply 6, 8, and 12 pin plugs at the following **PRICES 4/6, 5/6,** and **8/6** a pair respectively.

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MICROPHONES. No. 3 Mike in bakelite case with press-to-talk switch, complete with transformer. **PRICE 12/6.** Respirator Mike, complete with plugs, cord and transformer. **PRICE 10/6.** Postage 2/-.

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F.S.6 TRANSCEIVERS. We have been fortunate in securing a further stock of these. Complete with power pack, headphones, mike, vibrator, leads, and valves. A LIMITED NUMBER ONLY. **PRICE £22/10/-.**

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BLOWER MOTORS. 80, 12 and 24 volts, all with laminated fields, for A.C. or D.C. use, ideal for small ventilation jobs, cooling systems, etc. **PRICE:** 12v—**30/-;** 24v & 80v **35/-.** Postage 4/-.

50 volt 50 cycle MOTOR. Can be rewound to 230 volts single phase 1/10th h.p. **PRICE 25/-.** Postage 7/-.

CROYDON MOTORS. 24 volt A.C., D.C. Made by the Croydon Engineering Co. of England. Approximately 1/8th h.p. 3000 r.p.m. Compound wound. Length of shaft 7/8" x 5/16" diameter. **PRICE £1/19/6.** Postage 6/-.

DELCO MINIATURE MOTORS. 24 volt, shunt wound, 5400 r.p.m. Approx. 1/20th h.p. with shaft both ends, suitable for A.C. or D.C. operation. **PRICE £2.** Postage 3/-.

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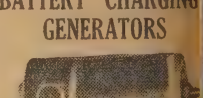

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year's position of divisional secretary. and Mrs. Ted Davies, VK2FE, fill the tion of treasurer and assistant-treas- respectively. Other positions are as w: Assistant-secretary, Bruce Thomas, FD; class secretary, Dave Evans, AYE; class supervisor, Allen Appleby, BF; QSL officer, Jim Corbin, VK2YC; officer and VK2WI co-ordinator, ghan Wilson, VK2VW; bulletin des- officer, Peter Vesper, VK2PV; coun- liaison officer, Bill Moore, VK2HZ; officers and correspondents, North t, Crieff Rettalick, VK2XO, Hunter ch, Harold Whyte VK2AHA, coal- s and Lakes, Harry Hawkins, VK2YL, ern, Hugh Stitt, VK2WH, South Coast southern, Roy Reyner, VK2DO.

esident of the UHF section, Bob Black, QZ, and Fred Phillips, VK2ZQ, chair- of the disposals committee, were ted ex-officio members of the council. e constitution committee comprises Moyle, VK2JU, chairman, Fred ips, VK2ZQ, and Bill Moore, VK2HZ. will report back to the council and bers on the Federal uniform constitu- and on other matters concerning policy and standing orders.

e council hopes to receive the support ll members during the ensuing year necessary for the efficient function- of the division.

e special meeting and normal general ting in May were extremely well nded.

CIAL MEETING

e special meeting was convened to ider a proposed change of articles h would take the power of governing nstitute at present vested in the coun- nd pass it to the general meeting. The t was keenly debated for 2½ hours it was decided by a substantial rity to make no change.

sitors included Varley Fitton, VK2SF, etary of the Hunter branch, VK3QX, CU and PAOASB, the latter two will naking their homes in Sydney. During general meeting 50 mc worked all s. Certificates were presented to Fred , VK2ABC, Vaughan Wilson, VK2VW, Ern Marstella, VK2AEZ.

e Hunter branch has decided on a l feature which it is hoped will assist keep up interest in branch affairs. meetings annually will be held at land instead of the normal venue at casle. The first meeting will be held ugust and the lecturer will be Joe l, VK2JR.

ith Rudkin, VK2DG, lectured at the meeting of the branch on his unit- communications receiver. Keith's and contest record are well known the new receiver, judging from its ut and performance, should keep well to the fore in future activity.

e silver anniversary of the founda- of the New Zealand Association of o Transmitters Inc. was celebrated in ington with the holding of a special ention over King's Birthday week- Amateurs from all sections of the inion attended.

GANISATION IN NZ

e general organisation of the NZART ery similar to our WIA with sections l districts (equivalent to our divisions, ough more numerous). A headquarters cated in one of the districts and fills position of our Federal executive. council is elected annually from eurs from each of the callsign areas really acts in a similar manner to Federal council.

ch year items are assembled from all ches for general discussion and sion. Those listed this year could y be mistaken for our Federal agenda r, even to the extent of including a of our specials that appear annually. ew of the more typical ones are as w:

request that the power allowable for ation on 50 mc and above be increased 0 watts.

at a probationary period be estab- d for new amateurs, operation to be restricted to CW on the 7 Mc band for six months.

NZ amateurs will be requested to forward reports to the appropriate authorities on commercial stations operating within the amateur bands.

Of interest is a proposal to run a WAP contest in place of the normal VK/ZL DX contest. This would mean that all stations in the Pacific area would participate in the contest instead of only the VKs and ZLs, that is, they would be contacting stations outside the Pacific area.

There is also a suggestion that NZART amateurs co-operate with the NZ Institute of the Blind and assist with technical advice on the Talking Book service in a similar manner to the assistance rendered by British amateurs.

The special allocation for CW on the low end of the 80 metre band was also discussed and suggestions for the width varied from 25 to 55 Kc/s.

You will see that N-Zedders' ideas run along lines parallel to our own.

The NZART recently ran a New Zealand-wide art union, making an extremely handsome profit. A source of revenue untouched here in Australia. Their QSL bureau also runs at a profit—£50 for the past year.

When the list of nominees for the council is presented in the official organ Break In a brief history of each candidate is printed showing his work in amateur radio. This is a departure of value to country amateurs who perhaps have had no opportunity to meet any of the candidates. It is of course even more important in NZ, as candidates stand from each of the four licensing areas.

UR OPPORTUNITY

oin the world-wide ranks of amateur nsitters! The Wireless Institute of ralia holds regular classes in Sydney sist Sydney and suburban enthusiasts btain their Amateur Operators Certi- s of Proficiency.

e for particulars to the Class Man- , W.I.A., Box 1734, G.P.O., Sydney.

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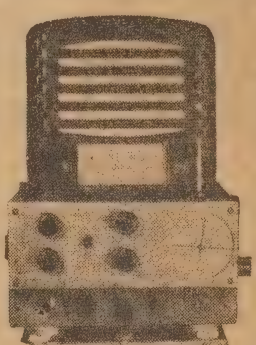

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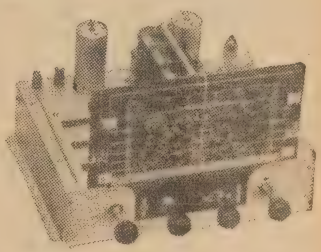

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EXCELAIR RADIO

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OFF THE RECORD — NEWS & REVIEWS

Highly interesting have been the reactions of public and musicians to the new auditorium described in our last month's issue, and erected on Britain's Festival grounds. These reactions are also important, for they represent probably the first of their kind to really controlled acoustics.

By JOHN MOYLE

THE Festival Hall, you will remember, was built to careful design, shaped to avoid reflecting surfaces, the sides and roof broken up and adjustable for reverberation, a reflecting area provided before the platform to ensure adequate transmission throughout the auditorium of middle and high frequencies and so on.

These controlled acoustics are in marked contrast to those of the average concert hall, not only in England but almost everywhere else. Most English and European concert halls have been built for many years. Little attention was paid to their acoustic qualities and only the more elementary facts of acoustics were known to those who designed them.

This hit and miss character of so many large halls and churches has profoundly affected our listening and performing habits for generations, if not for centuries. I think it is true to say that until recent years no one knew just what the acoustics of a hall would be until it was built. It was designed primarily to seat a given number of people, who would reach their seats through convenient corridors and stairways and who could see more or less what w going on.

As a result there are some fa tastic acoustic effects in existen There is one church in Scotland w such a terrific echo that it just ca be used for anything. It's quite stunt to sing or play in it the no of a common chord just to hear th held and sustained by the echo.

That's a bad case, of course. E we are all familiar with the drap curtains and strung wires used in t past to make something of a lo igh hall around which the ech of a voice will persist for ma seconds.

One of the worst auditoriums the world must be the circular Alb Hall in England, which seats 10,(people.

ACOUSTIC MATERIALS

We have learned a great deal abo acoustics in recent years and, mo over, we have developed a numb of excellent materials for such thin as lining auditoriums. By design a controlled use of such materi engineers can now produce halls, which the Festival Hall is example, free from the confusion sound that makes a performa heard in the balcony a totally diff ent thing from that heard in t stalls.

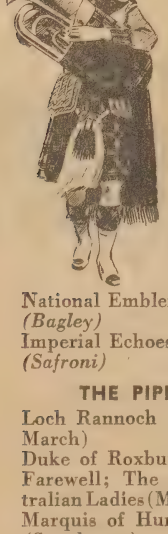
It was only to be expected t public reaction to the new hall wo be watched with interest. The fi works weren't long coming. Ea reports were inclined to be t reservedly favorable, even thou the comments themselves indica that the observers were puzzl Then Sir Thomas Beecham, w finally got around to conducting orchestra in the hall, flatly n nounced that it was no good and wouldn't conduct there again.

SECOND THOUGHTS

At this, other people began to ha a second think. They remembe that of two famous orchestras had sounded magnificent and other terrible, that a pianist no for his lovely sustained tones fa to reproduce them in the hall, a so on.

All this makes one long to r the comment of the men who desi ed the hall, for I at least have alw found it difficult to interpret some the descriptive phrases used musicians — and record review also!

But it seems to be pretty obvi that in this instance at least we h a hall which allows a performa to be heard pretty much as it rea

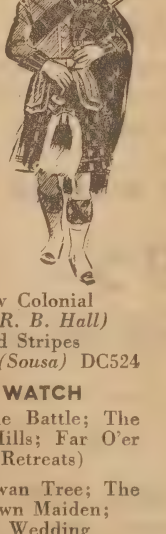


RECORDINGS BY THE BAND OF THE

BLACK WATCH

(Royal Highland Regiment)

Under the direction of Bandmaster LAURENCE H. HICKS



Jubilee *(L. H. Hicks)* On the Mall *(Goldman)* DC522

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The elimination of excessive nances and standing waves have oved the layer of mud and fug ch concertgoers have been used earing over all concert hall per- nances. This layer has been er merciful to us in the past, for, scumbling in painting, it tended bscure a host of imperfections of ure and finish in a comforting haze, vaguely pleasant if you en't too much interested in the per edges.

ur Sydney hall is a good example is fuzzy acoustic quality. So was ourne's until a convenient fire ed a rebuilding on very much intelligent lines.

e point is, however, without ng inter-city fights, that I'm sure ertgoers in England have become sed to hearing hall acoustics rimposed on their music, and uctors have become so used to ng heavily on the same thing, they just can't understand what happened when someone blows the fuzz and leaves the per- ance naked and ashamed.

n sure they are perfectly right saying that one performance ds good and another bad, despite ast that both are given by really rate orchestras.

ORDED PERFORMANCES

who listen to gramophone re- have been aware of all this long time. We have puzzled performances which just didn't right, we have sighed over a ding hall which prolonged the for too long a period, and re- much more violently to re- ngs in which the studio en- rs have obligingly removed trace of reverberation, to give e impression of an orchestra ng in a strongroom or some ly inhospitable place.

t occasionally we have come s a performance by an orches- which first of all could play ly, authoritatively, perfectly, ded in a chamber which al- every sound and color to be oped without acoustic confusion, yet with enough "air" to avoid lose-up effect. I think this is about what has happened to concert-goers in England, fresh the Albert Hall and its mist of echoes.

m not particularly making the that the deadly faithfulness seems to characterise the Fes- Hall is always a good thing. ut question, there will be many ons when it will be a magni- thing, when a fine performance have a thrill-making quality, not merely of big sound, but recision, clean outline, sharp

SANT EFFECTS

would not say that a singer ning for a resonance to build s tone and power, or a pianist ning his notes through the same m, is not a very pleasant thing ar.

I do think that those who wish ve perfect performances in the hall, or in its equivalent re- ng studio, must be absolutely sure of themselves before they start —sure that their work will stand examination with a high-powered microscope of an ear, in the knowledge that every departure from perfection will be clearly detected and made audible just as clearly.

I shall be extremely interested to watch for further comments about the new hall, particularly as more experience is obtained with it. It is highly likely that it will be used for recordings sooner or later, and we should hear more of it, one way or another. I certainly hope that it will not be "given away" by conductors and artists because it is too hard on them.

SPEAKER SHORTAGES

I don't know just how much truth there is in it, but I have heard that some of the high-quality imported speakers we have been getting during the past few years may be fewer and further between before very long. Shortage of materials is probably the reason, particularly of magnet steel.

The large, powerful magnets found on these speakers are an essential factor in their performance, and each of them takes up enough to make a number of smaller speakers.

There is no ready answer to this problem, which, incidentally, has weighed very heavily with our local speaker manufacturers in their plans for high-quality jobs.

Those of you unable to get microgroove records in Australia might take some comfort from the general experience in England, where apparently they are just about as hard to obtain as anywhere else. According to report, it's not just a matter of walking in and buying from the shelf. You have to take your turn, the same as we do over here.

Decca still seems to be in possession of the field with the long players. There's been no sign of movement elsewhere. Just a big market that grows and grows and looks forward to the day when the promise of the present will be fulfilled in the future!

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ANSWERS TO CORRESPONDENTS

). (Otago, NZ) sends in 2/6 for a of the Shortwave Handbook and he enjoys reading Radio and Hobbies. Your copy of the Shortwave Hand- has been forwarded to you and rust that you will find it of much ance. Best of luck with your eur transmitting activities.

.N. (Dargo, Vic) sends some queries battery charging and has some things to say about the magazine. Many thanks for your kind re- s. J.A.N., although we can't agree the ratio of radio to hobbies is as you say. Anyhow, we hope to keep ving you value for your "bob." We iot familiar with the generator you ion, but it is unlikely that any volt- regulator will be necessary, provid- ie speed can be set to give the cor- harging rate and will remain reason- constant. About 2.5 volts per 2 volt are usually allowed to ensure full e, so that it is hardly correct to say it must "merely be not less than" battery voltage. If less than 2.5 is applied the battery will not be charged.

are afraid the science question is f line, but we will pass the idea on alvin Walters who may be able to ie some reference to it in a future e.

Y. (Lilyfield, NSW) is worried by ffect of blackouts on electric clocks suggests that we publish details of ttery-operated clock.

Details of a battery-operated ium clock were published in and Hobbies for July, 1944, have been reprinted in pamp- form which is available from this , price one shilling. The sim- ommercial units you mention were satisfactory timekeepers provided voltage was maintained reasonably ant.

. (Woodville, SA) writes to tell us much he appreciates Radio and ies, and of his interest in the various bands. Unfortunately, B.R. has confined to a hospital bed for the 12 months but has turned the time ood account by studying for his .

Many thanks for an interesting . B.R., and for the nice things have to say. Very sorry to hear your long spell in hospital but ast you have not wasted your time now that your health seems to be oving, we hope it won't be long e you join the ranks. As you say, erial you are using at present is ery efficient and if you could manage thing better we feel sure you would ewarded by vastly improved results. yway, keep up the good work, as is still plenty of scope for experi- and the experience should stand n good stead when the time comes our exam. Your subscription has forwarded to the appropriate de- ent, from which you should have ved a receipt by the time you read

.W. (Taringa, Q.) writes in appreci- of Radio and Hobbies, and describes of the sets which he has built from lesigns. He also mentions some of difficulties encountered in his dis- including tropical humidity, short- and high prices.

Glad you find the designs so use- A.H.W., and you certainly seem to have made use of quite a number of them. As you say, some of the conditions you encounter do tend to make things a trifle expensive, although a little patch and make do will usually work wonders. We hope you will continue to enjoy the various articles you mention.

R.V.F. (Naracoorte, SA) sends a subscription for 12 months and asks some questions about the Kar Set.

A.: Thanks for your subscription, R.V.F., and this has been forwarded to the appropriate department. In some cases it has been found necessary to eliminate all earth connections between the filament line and the receiver chassis, earthing it only at the power supply, to eliminate the last trace of hash. The high noise level in the RF stage may be due to oscillation of this section and this may be confirmed by decreasing the gain temporarily by reducing the screen voltage for example, and noting if the noise is eliminated. It must be realised that the noise level produced by any high gain set will be high when no signals are being received, as the set is working at maximum sensitivity under these conditions.

K.K. (Canberra, ACT) writes in appreciation of Radio and Hobbies and makes some suggestions for articles he would like to see published.

A.: Many thanks for your kind remarks, K.K., and it is nice to know that you find the magazine so interesting. Your suggestions have been noted, and we will keep these ideas in mind for possible inclusion at a later date. We would point out, though, that there have been quite a number of tuners of various kinds described over the last few years, as well as a large variety of amplifiers, and it should be possible for almost any combination of these to be made into a Radiogram.

K.L. (McKees Hill, NSW) suggests that the Twin Speaker Mantel Set would make an excellent tablegram, since the dial and controls would be accessible from the front, rather than from under the lid.

A.: Many thanks for the suggestion, KL. It frankly had not occurred to us but the chassis obviously lends itself to the idea. Many thanks for your encouraging remarks about the magazine.

K.W. (South Camberwell, Vic.) has been studying the Learn While You Build It articles and is anxious to incorporate the Twin Tune idea in more advanced sets, such as TRF's and superhets.

A. Many thanks for your interesting suggestion, K.W., and we are glad to know you have found the articles instructive. The scheme you suggest is hardly necessary, as the types of circuits you mention achieve the same characteristics by what are really better methods, although they are more complicated and more costly. Particularly in the case of a superhet such additions should be quite unnecessary as a correctly adjusted set of this type is capable of as much selectivity as required, in fact, in many cases there is too much. We suggest that you follow this series to its conclusion, when we think you will be in a better position to assess the value of such schemes.

G.S. (Newcastle, NSW) inquires about the availability of a ready-made chassis for the 1951 Advance.

A. Blueprints of this chassis have been sent to the manufacturers, and, excepting for any temporary shortages, should be available from our advertisers by this time. If you care to make your own we can supply a blueprint through our mail service at a cost of 2/6.

H.J.B. (Williamstown, Vic.) wants to build the Christmas Box Mantel described in Radio and Hobbies for December, 1950, but would like to modify it for switched tuning and requests that we supply the values of capacitance to switch to the ten local Melbourne stations.

A. We regret that this comes under the heading of special circuits and calculations, and we just do not have the time to handle queries of this nature. The scheme is quite practical provided you can find space for the extra components. We would suggest that you use adjustable padders in conjunction with fixed capacitors to give you the required values, which will have to be found by experiment. As a guide, remember that a gang when fully meshed has a value of about 420 pf. per section.

C.T.V. (Matraville, NSW) is interested in our current photographic series and sends a useful hint for users of developing tanks.

A. Many thanks for your interest and the hint, C.T.V. Although not new, this is a very useful point to remember and we will keep it in mind for inclusion in a future article devoted to tank working. For your own benefit we would add that it is not necessary to unload in darkness if the tank is filled and emptied twice with clean water, when it will be quite safe to proceed in subdued artificial light.

E.F. (Erskineville, NSW) sends us a circuit from an oversea magazine and suggests that if it were redesigned for 240 volts it might be described in Radio and Hobbies.

A. Thanks for the suggestion, E.F., but frankly we are not keen on circuits of this kind. In the first place there are problems associated with converting such equipment for 240-volt operation. The most objectionable feature is the very real danger which results when sets of this kind are connected to the mains without the use of a transformer, particularly when headphones are recommended, as in this case. Even when operated on 110 volts, such a device can hardly be regarded as safe, so that it is quite out of the question for 240-volt supplies.

M.R.C. (Randwick, NSW) wants to know if we have ever published details of a two-valve battery-operated short-wave receiver and, if so, whether it would be possible to obtain a copy of the circuit.

A. We have nothing on our files to exactly suit your requirements, the nearest being the "All-Wave Battery Three," published in March, 1943. Circuit, wiring diagram and parts list are available, as well as a pamphlet of short-wave coil winding details. Total price is 2/6. In the AC range there is the "Three-Band-Three," published in February, 1951, full details of which are available, price 2/-.

J.J. (Eltham, Vic.) has built the Minivox receiver and gets good reception of

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes, and cutouts will be supplied if available for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, "Radio & Hobbies," Box 2728C GPO, Sydney.

LEASE WRITE CLEARLY

EASE write your name and address clearly on all correspondence or, for ference, print them in block capitals. often have the greatest difficulty in iphering names. At present we are ding a letter to P.L.J., of Moonah, bart, which has been returned twice ng to an apparently incorrect ad- ss.

Readers say:

I would like to raise a couple of points which have not yet been mentioned in the "Argument" series.

The first is a rather minor matter but one which has caused me some bother lately. All 78 rpm records appear to have an eccentric run-off groove which imposes unnecessary strain on the pick-up. It has been my experience that the violent swinging to and fro of the pickup can, after a time, cause "poling" in certain types of needle-armature pickups which rely on the damping blocks to hold and centre the needle in a very small gap.

Of course, the pickup manufacturers must take their share of the blame for a poor design but I see no reason why the record manufacturers should not ease the position by using a circular run-off groove. If it is necessary to have a lateral movement to actuate record changers, then one lateral movement of the pickup into a circular track should be sufficient.

While on the subject of records, I would like to point out that 78 rpm records are still made at a level high enough to produce sound directly through the "pile drivers with exponential horns attached," which were called gramophones 25 years ago.

I contend that surface noise is now less of a problem than pickup distortion, which is function of the amplitude of vibration of the needle. Hence a reduction in recording level is indicated.

Of course, microgroove has done this but when will the other record companies realise that there are such things as high gain amplifiers and that it is no longer necessary to rattle the pickup from its pivots to get enough volume from the record? Incidentally, do the new microgrooves have the eccentric run-off and, if so, why?

On the subject of amplifiers, not much has been said about the distortion at low frequencies. Since, in normal sound reproduction, more volume is required to produce a given volume of sound at low frequencies, I consider that distortion tests on high fidelity amplifiers should be based on a frequency of say 20 cps. Intermodulation tests should also use a lower frequency of something like 20 cps. I consider that the present practice of using 400 and 4000 cps for intermodulation tests gives misleading results.—(W. L. Harvey).

★ ★ ★

I am grateful to those who showed, by their helpful replies, their unexpected interest in the remarks made in my letter published in your February issue.

In musical sound, the higher odd harmonics are discordant and, when allowed to intrude in the tone of a musical instrument, they produce a "jangle of metallic sound." Jeans in Science of Music quotes examples of this. When a violin is bowed other than perpendicularly to the strings, a squeaky irritating noise is produced, as those who have had to listen to inept bowing of a G-string will recognise.

If the felts on the action of a piano become worn or hard, the 7th, 9th, 11th, 13th and higher odd harmonics are heard, introducing harshness or roughness into the tone.

In addition to the fundamental and its obvious harmonics, the instrument produces a background of noise in a continuous spectrum most noticeable in the higher frequencies as, for example, the "whiskers" on the tone of a brass instrument when the player is not at his best.

The control of the unwanted background and overtones involves some effort and study both by the maker of the instrument and by the player and, in this direction, the aims of the sound engineer and the musical profession appear to diverge.

The most noticeable effect of extending the upper frequency range of the amplifier is to reproduce more distinctly these imperfections, so that the equipment may logically be regarded with much the same disfavor as an acquaintance who insists on telling the whole truth under all circumstances—(M. Newbold).

★ ★ ★

I am very disappointed with the absence of bass in modern recordings. I know there are bass-boosting preamplifiers but why should I have to spend time and money experimenting with more amplifiers to get what I previously did without them. I am particularly interested in organ discs but what a mess they have made of them!

I always say "simplicity for efficiency." As far as reproduction is concerned, the record is the starting point and everything we desire should be on that disc. If I could buy a 10-inch disc of a theatre organ which had the very low frequencies without distortion but only ran for two minutes, I would prefer it. Quality is of first importance with me.

Personally, I suspect that the bass notes have been taken away for the purpose of making cheap radios sound better. Tin-pot chassis are placed in resonators, usually called cabinets and, when a well-balanced record is played, the result is a monstrous boom and a man's voice sounds like a foghorn. Play a modern record with the bass pinched out of it and the tin-pot radio sounds better.— (E. Luke).

ANSWERS TO CORRESPONDENTS

(Continued from previous page

stations at the high frequency end the band, but can get nothing lo than about 1200 Kc.

A. This is rather an unusual fault in the absence of further details it difficult to say what may be the ca If the stations you do receive are loca in the lower capacity half of the g range (i.e., plates out of mesh) it wo seem that the tuned circuit compone are correct in value, but that the g plates might be shorting as they co into mesh. If the stations are recei at the maximum capacity end of range it would seem that the coil at fault, either the wrong type, wr winding used, or simply faulty, tho we think this unlikely. You do not whether the regeneration circuit is wo ing correctly, and this is important sets of this type. Satisfactory regen tion is sometimes prevented by ac loading, and an improvement can o be effected by coupling through a sm capacity condenser, say, 100 pf.

C.W.S. (Kurri Kurri, NSW) inqu as to whether we have any pamph on wireless work, and the cost.

A. Sorry, C.W.S., but we have noth as comprehensive as you require. can only suggest that you obtain so elementary text books, and study th in conjunction with those articles Radio and Hobbies designed for be ners, such as our current "Learn W You Build It" series. Suitable text bo should be available from any of the l bookstalls, such as Angus and Rob son or Dymock's and you should be to obtain catalogues from these firm you specify the type of book you req

H.S. (East Brighton, Vic.) sends months' subscription to R. and H., inquires if we can publish a circuit a 6-volt DC two or three-valve set.

A. Your subscription has been warded to the appropriate departm H.S., and you will no doubt receive official acknowledgement before you this. We regret we are unable to de special circuits for individual reac and our files do not contain any des along the lines you mention. We published several vibrator sets for op tion on a 6-volt battery, including "Kar-Set" in May, 1949, but these all larger than you mention. Perh some further details of the exact conditions under which it is to oper would enable us to help you further.

B.A. (Sydney) writes to tell us of success with a number of our sets, cluding a combination of the "S Tuner" and the "1950 Radiogram," "Super Eight," the "Fireside Five," He also draws our attention to a s error in the text of "Super Tun namely, the screen resistor of the 6C is given as .7 meg. for 250-volt su when it should obviously be .07 meg.

A. Many thanks for your kind rema B.A., and we are glad to know that have had so much success with our v ous circuits. We also appreciate drawing our attention to the error, w fortunately is quite obvious. As you the quality of program material le a lot to be desired from many stati and a wide range tuner shows this to a marked degree, and it is usu necessary to select programs with r care than with an ordinary set. Bes luck with your studies.

A.S. (Sth. Fremantle, WA) raise question on the size of tuning capa to use in the Three-Band-Three described in the February, 1951, of R. & H.

A.: The size for the tuning capa of .0004 mfd (400 pf) as quoted in parts list for this set is a nominal fi because of the slight variations in value of maximum capacitance of ca tors of different manufacture. V some types will have a maximum around .00039 mfd (390 pf), others go up around .00042 mfd (420 pf). same percentage change in the mini value of capacitance is very small could be neglected but differing const tional features will produce a vari in the minimum value of 10 to 20 The overall result, however, is m a small change in the tuning ratio in the case of the set in question. size having a maximum value ar the 400 pf mark can be used.

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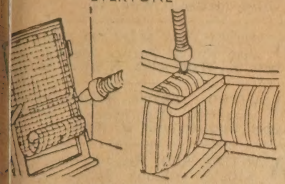

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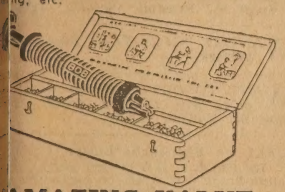

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THE FUTURE WILL BRING NEW JOBS

(Continued from Page 11)

of popular flying comes it may be a different matter.

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LET'S BUY AN ARGUMENT

(Continued from Page 63)

Valve VI is a cathode follower and it is reasonable to assume that there will be a slight loss of gain between grid and cathode. An input of say "1.1e" might produce a signal "e" at the cathode. This is transferred via C2 to the grid of V2.

There would normally be a degenerative effect across R4 but it will be partially countered by the out-of-phase current of V3. This would land us right back at the "push-half-pull" arrangement, were it not for the fact that the cathode current of the voltage amplifier V1 also flows through R4 and in phase with that of V2.

It would appear, from a report on the MIT report, that the cathode component from V1 can correct the "push-half-pull" situation and allow full and balanced drive to reach V3 via the cathode circuit.

This being so, the balanced cathode components of V2 and V3 should in themselves cancel out across R4. However, the extra component from V1 through R4 would ideally set up a voltage e/2 across it, which becomes the cathode drive of V3. The grid drive effective for V2 is e m e/2 which is also equal to e/2.

It does appear therefore, that drive on the two grids could balanced and kept at quite low pedance.

But does the arrangement sa valve by obviating the phase s ter? The answer, I fear, is no.

The effective signal voltage each of the push-pull valves is for an original input of 1.1e thereabouts. In other words gain of V1—total input/total put—is about 0.9 times.

Against this, the gain of a ventional phase splitter is 1.8, a comparable figure for a phase verter might be expressed as since it effectively doubles the nal by providing drive for a se output valve.

Mr. Hardy would then need a age amplifier ahead of his ci for normal overall gain.

Printed and published by Assoc Newspapers Ltd., at the registered of the Company, 60-70 Elizabeth S Sydney, N.S.W.